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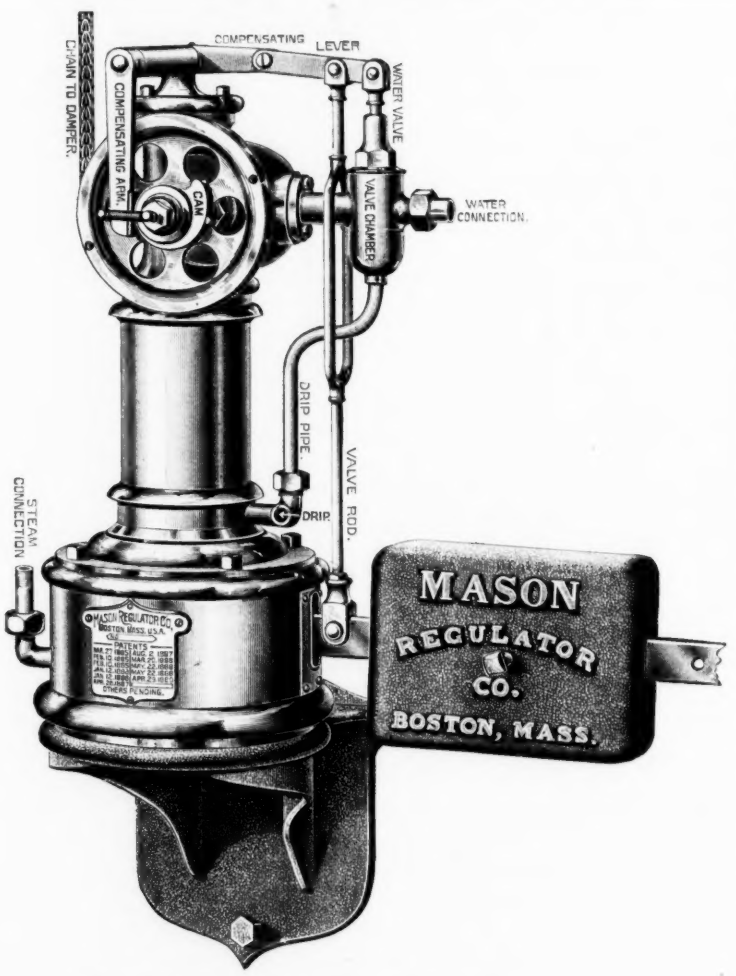
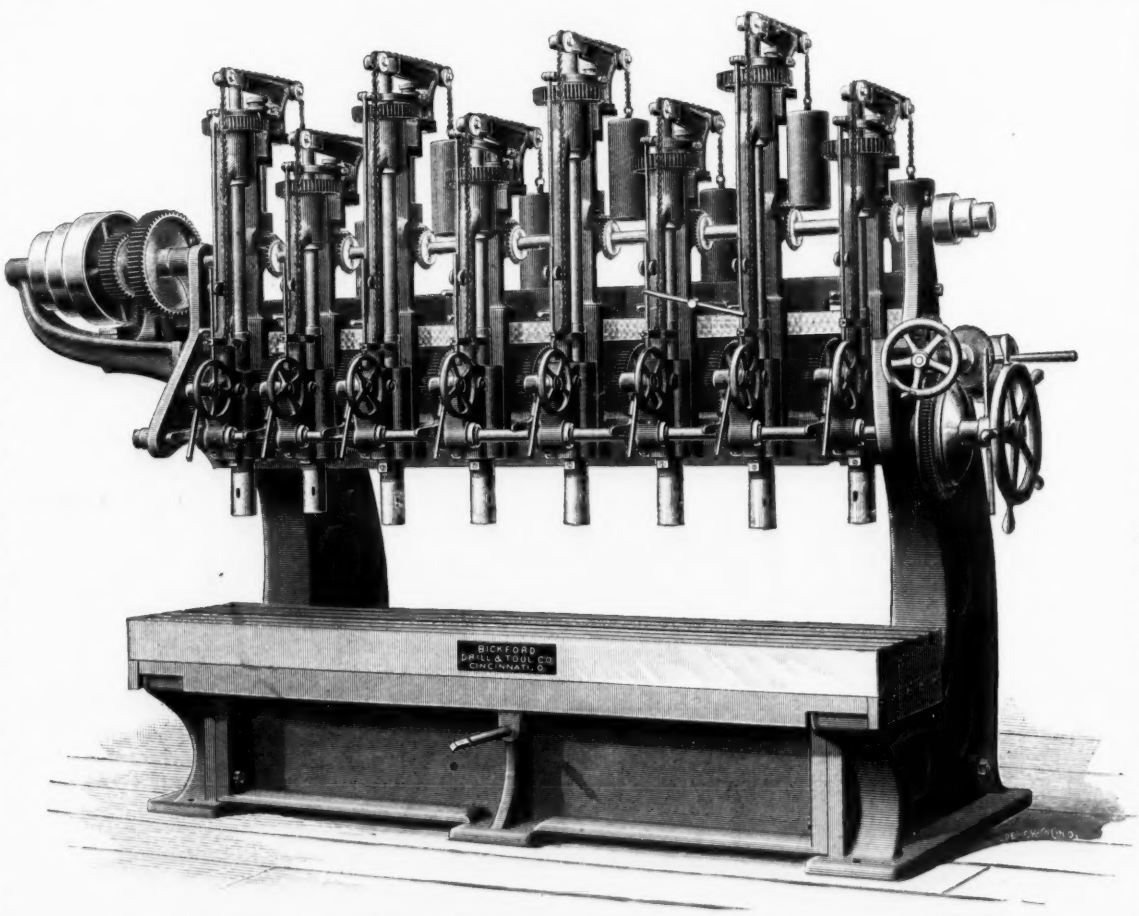
## Mason Hydraulic Damper Regulator.

The Mason Regulator Co., of Boston, have recently put upon the market a damper regulator, which we illustrate. It belongs to that class of regulators which are controlled by the variation of the boiler pressure, the motive power for opening or closing the damper being the water pressure, which can either be taken from the street mains or from the boiler itself. The principal advantage of using the water pressure is the constant and non-variable movement which is obtained. In this particular regulator the steam from the boiler enters through the tube marked "steam connection," thence under a heavy rubber diaphragm. As a matter of fact, it is only water which comes in contact with the diaphragm, as the steam in the chamber soon condenses. In the cut the regulator is represented in the position occupied when the damper is closed, and the piston in the cylinder directly under the wheel is at its lowest point, the "water valve" being open. Supposing the steam pressure in the boiler falls, and the damper is required to open, the following action results: The heavy weight on the lever not being sustained by the pressure under the diaphragm, falls, carrying the "valve rod," and closing the "water valve," which is contained in the "valve chamber." The water which has held the piston down flows off through the "drip pipe," and allows the weight which is hung on the damper in the flue at the other end of the connecting chain, to open the damper, pulling with it the wheel on the regulator. It is obvious that if this were the only mechanism the damper would at all times either be entirely open or completely closed at each change of steam pressure in the boiler. This would produce a variable draught and increase the consumption of coal. A compensating arrangement is therefore provided, by which, as the wheel turns, the cam throws out the compensating arm. This throws down the compensating lever, and, making a new fulcrum where it joins the valve rod, tends to decrease the downward or closing tendency of the water valve, which is, during this time, being drawn down by the valve rod, so that the water pressure is not entirely removed from the piston in the main cylinder. All of this action takes place within a variation of less than one pound in the boiler pressure. When the boiler pressure rises, the valve rod is thrown up, opening the water valve, and turning the wheel in the reverse direction, closing the damper. The compensating arrangement works in a reverse manner to that described above. The machine is fully nickel plated, and a bracket, weight and chain are furnished with each one.




MASON HYDRAULIC DAMPER REGULATOR.

It is said that the Coreans built the first ironclad, about 300 years ago.




MULTIPLE SPINDLE DRILLING MACHINE.

## Multiple Spindle Drilling Machine.

The accompanying illustration is of a multiple spindle drilling machine, having eight spindles, capable of using up to 2-inch drills, and with the heads so designed that they can be set very close together, the minimum distance from center to center of holes, without moving the table, being 6 inches.

Motion is taken from the horizontal shaft which is driven by cone pulley and back gearing, this by means of miter gears and short vertical shafts back of each spindle, driving the latter; the spur gears on the spindle being 10 inches diameter, and their ratio to the pinions driving them nearly 3 to 1. The fact that alternate spindle driving gears are placed lower than the others allows gears 10 inches diameter to be placed at 6 inches center distance.

The spindles are counterbalanced, have quick motion by hand, and are provided with automatic feed stops which act, either independently or together, as may be desired.

The table on which the work rests moves in two directions, and can be set by graduated disks reading to 64ths or 100ths, thus enabling holes to be drilled any desired distance apart.

The heads are moved upon the rail by rack and pinion, and all important gears and shafts are of steel. The machine illustrated is an example of a line of such machines, which have been built with from two to twelve spindles, and for lighter work in some cases. This machine when being tested drilled eight 2 inch holes through 10 inches of steel plate without perceptible strain or vibration.

The machines are especially adapted to the use of engine and locomotive builders, boiler, car and safe shops, and are built by the Bickford Drill and Tool Co., 3 Pike street, Cincinnati, O.

Of all the fine-spun theory of steam engineering, the average steam-engine user knows little and cares considerably less. Even doctors do not know much, if anything, about the exact operation of some of the more common drugs, but they are fairly content with knowing their effect. So steam engine users are content with the results, and look upon the efforts of engineers to fix exact reasons as simply harmless. It does not, they think, make much difference whether the reasons are formulated this year or in ten years, in which opinion they appear to be about right, from their point of view.

The trolley car was put to a new use in a near-by city one morning recently. A thief was escaping in a hack, and a policeman boarded a trolley car, and the motorman let her out in chase. The horse gave out first, and the thief was captured. Some good in the trolley car after all.

## Comparison of Different Formulæ for Dimensions of Parts of Steam Engines.—III.

By William Kent, M. E.

*The Crank pin (continued).*—Whitham recommends for pressure per square inch of projected area, for naval engines 500 pounds, for merchant engines 400 pounds, for paddle-wheel engines 800 to 900 pounds.

Thurston ("Steam Engine Design," p. 109) says the pressure should, in the steam engine, never exceed 500 or 600 pounds per square inch, for wrought iron pins, or about twice that figure for steel. He gives the formula for length of a steel pin, in inches,

$$l = \frac{P\,R}{600{,}000} \qquad (3)$$

in which $P$ and $R$ are the mean total load on the pin, in pounds, and the number of revolutions per minute. For locomotives, the denominator may be taken as 500,000. Where iron is used this figure should be reduced to 300,000 and 250,000 for the two cases taken. Pins so proportioned, if well made, and well lubricated, may always be depended upon to run cool; if not well formed, perfectly cylindrical, well finished, and kept well oiled, no crank-pin can be relied upon. It is assumed above that good bronze or white metal bearings are used.

Thurston also says: The size of crank-pins required to prevent heating of the journals may be determined with a fair degree of precision by either of the formulæ given below:

$$l = \frac{P(V+20)}{44{,}800\,d} \text{ (Rankine, 1865)} \qquad (4)$$

$$l = \frac{P\,V}{60{,}000\,d} \text{ (Thurston, 1862)} \qquad (5)$$

$$l = \frac{P\,N}{350{,}000} \text{ (Van Buren, 1866)} \qquad (6)$$

The first two formulæ give what are considered by their authors fair working proportions, and the last gives minimum length for iron pins. ($V$ = velocity of rubbing surface in feet per minute.)

Formula (1) was obtained by observing locomotive practice in which great liability exists of annoyance by dust, and great risk occurs from inaccessibility while running, and (2) by observation of crank-pins of naval screw engines. The first formula is, therefore, not well suited for marine practice.

Steel can usually be worked at nearly double the pressure admissible with iron running at similar speed.

Since the length of the crank-pin will be directly as the power expended upon it, and inversely as the pressure, we may take it as:

$$l = a\,\frac{I.\,H.\,P.}{L}, \qquad (7)$$

in which $a$ is a constant, and $L$ the stroke of piston, in feet. The values of the constant, as obtained by Mr. Skeel, are about as follows:

$a = 0.04$ where water can be constantly used,
$a = 0.045$ where water is not generally used,
$a = 0.05$ where water is seldom used,
$a = 0.06$ where water is never needed.

Unwin gives:

$$l = a\,\frac{I.\,H.\,P.}{r}, \qquad (8)$$

in which $r$ = crank radius in inches, $a$ = 0.3 to $a$ = 0.4 for iron and for marine engines, and $a$ = 0.066 to $a$ = 0.1 for the case of the best steel and for locomotive work, where it is often necessary to shorten up outside pins as much as possible.

J. B. Stanwood, in *Engineering*, June 12, 1891, in a table of dimensions of parts of American Corliss engines from 10 to 30 inches diameter of cylinder gives sizes of crank-pins which approximate closely to the formula:

$$l = 275\,D' + .5 \text{ in.},\quad d = .25\,D' \qquad (9)$$

By calculating lengths of iron crank-pins for the engines 10, 30 and 50 inches diameter, long and short stroke, by the several formulæ above given, it is found that there is a great difference in the results, so that one formula in certain cases gives a length three times as great as another. Nos. (4) (5) and (6) give lengths much greater than the others. Marks (1) Whitham (2) Thurston (7) $l = .06\,\frac{I.\,H.\,P.}{L}$, and Unwin (8) $l = 0.4\,\frac{I.\,H.\,P}{r}$ give results which agree more closely.

The calculated lengths of iron crank pins for the several cases by formulæ (1) (2) (7) and (8) are as follows:

LENGTHS OF CRANK-PINS.

| Diam. of Cyl. ..... D. | 10 | | | 30 | | | 50 | |
|---|---|---|---|---|---|---|---|---|
| Stroke..... L. (ft.) | 1 | 2 | | 2½ | 5 | 4 | | 8 |
| Revs. per min..... R. | 250 | 125 | | 130 | 65 | 90 | | 45 |
| Horse-power. ..... I. H. P. | .... | .... | | .... | 450 | .... | 1250 | .... |
| Maximum pressure ..... lbs. | .... | 7,854 | | .... | 70,686 | .... | 196,350 | .... |
| Mean pressure per cent. of max..... | .... | .42 | | .... | 32.3 | .... | 30 | .... |
| Mean pressure..... P. | .... | 3,299 | | .... | 22,832 | .... | 58,905 | .... |
| Length of crank-pin..... | | | | | | | | |
| (1) Whitham, $l = .9075 \times .05\,\frac{I.H.P.}{L}$ ... | 2.18 | 1.09 | | 8.17 | 4.08 | 14 18 | | 7.09 |
| (2) Marks, $l = 1.038 \times .05\,\frac{I.\,H.\,P.}{L}$ ins. | 2 50 | 1 30 | | 9 34 | 4 67 | 16.22 | | 8.11 |
| (7) Thurston, $l = .06\,\frac{I.\,H.\,P.}{L}$ ... ... | 3.00 | 1.50 | | 10.80 | 5 40 | 18 75 | | 9.38 |
| (8) Unwin $l = .4\,\frac{I.\,H.\,P.}{\text{rad. of crank}}$ ..... | 3.33 | 1.67 | | 12 0 | 6.0 | 20.83 | | 10 42 |
| " $l = .3\,\frac{I.\,H.\,P.}{r}$ ... ..... ..... | 2 50 | 1.25 | | 9.0 | 4.5 | 15 62 | | 7.81 |
| Average..... ..... | 2.72 | 1.36 | | 9 86 | 4 93 | 17.12 | | 8.56 |
| (8) Unwin, best steel, $l = .1\,\frac{I.\,H.\,P.}{r}$ | .88 | .42 | | 3.0 | 1.5 | 5 21 | | 2.61 |
| (3) Thurston, steel $l = \frac{P\,R}{600{,}000}$ .. ... | 1.37 | .69 | | 4 95 | 2.47 | 8 84 | | 4.42 |

The calculated lengths for the long-stroke engines are too low to prevent excessive pressures. See "Pressures on the Crank-pins," below.

*The strength of the crank-pin* is determined substantially as is that of the crank. In overhung cranks the load is usually assumed as carried at its extremity, and, equating its moment with that of the resistance of the pin,

$$\frac{1}{2}\,P\,l = \frac{1}{32}\,t\,\pi\,d^3, \text{ and}$$

$$d = \sqrt[3]{\frac{5.1}{t}\,P\,l},$$

in which $d$ = diameter of pin in inches, $P$ = maximum load on the piston, $t$ = the maximum allowable stress on a square inch of the metal. For iron it may be taken at 9,000 pounds. For steel the diameters found by this formula may be reduced 10 per cent. (Thurston.)

Unwin gives the same formula in another form, viz.,

$$d = \sqrt[3]{\frac{5.1}{t}}\,\sqrt[3]{P\,l} = \sqrt[3]{\frac{5.1}{t}}\,\sqrt[3]{P\,\frac{l}{d}},$$

the last form to be used when the ratio of length to diameter is assumed.

For wrought-iron, $t$ = 6,000 to 9,000 pounds per square inch,

$$\sqrt[3]{\frac{5.1}{t}} = .0947 \text{ to } .0827;$$

$$\sqrt[3]{\frac{5.1}{t}} = .0291 \text{ to } .0238.$$

For steel, $t$ = 9,000 to 13,000 pounds per square inch,

$$\sqrt[3]{\frac{5.1}{t}} = .0827 \text{ to } .0723,$$

$$\sqrt[3]{\frac{5.1}{t}} = .0238 \text{ to } .0194.$$

DIAMETER OF CRANK-PINS.

| Diam. of cyl ..... | 10 | | | 30 | | | 50 | |
|---|---|---|---|---|---|---|---|---|
| Stroke, ft ... ..... | 1 | 2 | | 2½ | 5 | 4 | | 8 |
| Horse-power ..... | .... | .... | | .... | 450 | .... | 1250 | .... |
| Maximum load on piston ..... | .... | 7,854 | | .... | 70,686 | .... | 196,350 | .... |
| Length of crank pin..... | 2.72 | 1.36 | | 9.86 | 4.93 | 17.12 | | 8.56 |
| Unwin, $d = \sqrt[3]{\frac{5.1\,P\,l}{t}}$ ..... | 2 29 | 1.82 | | 7.31 | 5 82 | 12 40 | | 9 84 |
| Marks, $d = .066\,\sqrt[4]{p\,l^3\,D^2}$ ..... ... | 1.39 | .85 | | 6 44 | 3.78 | 12.41 | | 7.39 |
| Whitham, $d = 0.405\,\sqrt[4]{P\,l^3}$ (?)..... | 7.97 | 4.80 | | 36 8 | 21 9 | 71.8 | | 42.6 |

PRESSURES ON THE CRANK-PIN.

| Engine No. | 1 | | 2 | 3 | | 4 | 5 | | 6 |
|---|---|---|---|---|---|---|---|---|---|
| Diam. of cylinder, in ..... ..... .. | 10 | | | 30 | | | 50 | | |
| Stroke, feet ..... ..... | 1 | | 2 | 2½ | | 5 | 4 | | 8 |
| Mean pressure on pin, lbs..... | 3,299 | | | 22,832 | | | 58,905 | | |
| Projected area of pin, Unwin ..... | 6 23 | ... | 236 | 72.4 | .... | 28.7 | 212.3 | ... | 84 2 |
| Do., Marks ..... | 3.78 | .... | 1.16 | 63.5 | .... | 18 6 | 212 5 | .. | 63 3 |
| Pressure per square inch, Unwin .. | 530 | ... | 1398 | 315 | .... | 796 | 277 | .... | 700 |
| Do., Marks ... | 873 | .... | 2845 | 360 | .... | 1228 | 277 | .... | 930 |

Whitham gives $d = 0.0827\,\sqrt[3]{P\,l} =$

$$2.1058\,\sqrt[3]{\frac{l \times I.\,H.\,P.}{L\,R}} \text{ for strength,}$$

and $d = 0.405\,\sqrt[4]{P\,l^3}$ for rigidity, and recommends that the diameter be calculated by both formulæ, and the largest result taken. The first is the same as Unwin's formula, with $t$ taken at 9,000 pounds per square inch. The second contains an error, as is shown below.

Marks, calculating the diameter for rigidity, gives

$$d = .066\,\sqrt[4]{p\,l^3\,D^2} = 1.758\,\sqrt[4]{\frac{(H.\,P)\,l^3}{L\,N}},$$

$p$ = maximum steam pressure in pounds per square inch, $D$ = diameter of cylinder in inches, $L$ = length of stroke in feet, $N$ = number of single strokes per minute. He says there is no need of an investigation of the strength of a crank-pin, as the condition of rigidity gives a great excess of strength. The formula is serviceable, he says, for steel and for wrought iron alike.

Using the average lengths of the crank-pins already found, we have as given below for our six engines.

The large figures obtained from the last formula led to the discovery that 0.405 should have been printed .0405, which figure results from the calculation of the data given by Whitham, upon which he bases his formula, but this would give diameters only one-tenth of those in the last line of the above table. The basis of his formula is the assumption that the whole load if concentrated at a point $\frac{1}{3}\,l$ from the fixed end would cause a deflection at that point of $\frac{1}{800}$ inch. It is also assumed that this deflection is equivalent to a deflection of .01 inch at the outer end, which assumption is erroneous.

Marks's formula assumes that the whole load may be concentrated at the outer end, and cause a deflection of .01 inch at that point.

*Pressures on the Crank pins.*—If we take the mean pressure upon the crank-pin = mean pressure on piston, neglecting the effect of the varying angle of the connecting rod, we have the following, using the average lengths already found, and the diameters according to Unwin and Marks.

The results show that the application of the formulæ for length and diameter of crank-pins give quite low pressures per square inch of projected area for the short-stroke high speed engines of the larger sizes, but too high pressures for all the other engines. It is therefore evident that after calculating the dimensions of a crank according to the formulæ given that the results should be modified, if necessary, to bring the pressure per square inch down to a reasonable figure.

In order to bring the pressures down to 500 pounds per square inch, we divide the mean pressures by 500 to obtain the projected area, or product of length by diameter. Making $l = 1.5\,d$ for engines Nos. 1, 2, 4 and 6, the revised table for the six engines is as follows:

| Engine, No..... | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Length of crank-pin, in.. ..... | 3 15 | 3 15 | 9.86 | 8.37 | 17.12 | 13 0 |
| Diam. of crank-pin..... | 2.10 | 2.10 | 7.34 | 5.58 | 12.40 | 8.67 |

*The Crank Arm.*—The crank arm is to be treated as a lever, so that if $a$ is the thickness in direction parallel to the shaft axis, and $b$ its breadth at a section $x$ inches from the crank-pin center, then, bending moment $M$ at that section = $P\,x$, $P$ being the thrust of the connecting rod,

$$P\,x = \frac{f\,a\,b^2}{6} \text{ and } \frac{a \times b^2}{6} = \frac{T}{f}, \text{ or}$$

$$a = \frac{6\,T}{b^2 \times f},\quad b = \sqrt{\frac{6\,T}{f\,a}}.$$

If a crank-arm were constructed so that $b$ varied as $\sqrt{x}$ (as given by the above rule) it would be of such a curved form as to be inconvenient to manufacture, and consequently it is customary in practice to find the maximum value of $b$, and draw tangent lines to the curve at the points; these lines are generally, for the same reason, tangential to the boss of the crank-arm at the shaft.

The shearing strain is the same throughout the crank-arm; and consequently is large compared with the bending strain close to the crank-pin, and so it is not sufficient to provide there only for bending strains. The section at this point should be such that, in addition to what is given by the calculation from the bending moment, there is an extra square inch for every 8,000 pounds of thrust on the connecting rod (Seaton).

The length of the boss $h$, into which the shaft is fitted, is from 0.75 to 1.0 of the diameter of the shaft $D$, and its thickness, $e$, must be calculated from the twisting strain $P\,L$ ($L$ = length of crank).

For different values of length of boss, $h$, the following values of thickness of boss, $e$, are given by Seaton:

When $h = D$, then $e = 0.35\,D$; if steel 0.3.
$h = 0.9\,D$, then $e = 0.38\,D$, if steel 0.32
$h = 0.8\,D$, then $e = 0.40\,D$, if steel 0.33.
$h = 0.7\,D$, then $e = 0.41\,D$, if steel 0.34.

The crank eye or boss into which the pin is fitted, should bear the same relation to the pin that the boss does to the shaft.

The diameter of the shaft end onto which the crank is fitted should be 1.1 × diameter of shaft.

Whitham gives the following dimensions in inches:

$d$ = diameter of crank-pin; $l_1$ = length of crank-pin eye.

$c$ = thickness of metal around crank-pin; $L$ = stroke of engine.

$\frac{L}{2}$ = effective length of crank arm; $e$ = thickness of metal around shaft.

$f'$ = factor of safety, $f$ = safe shearing strength = $\frac{50{,}000}{f'}$ for wrought iron.

$g$ = length of crank hub; $r$ = radius of shaft.

$l_1 = 1.5\,d$, $c = \frac{1}{3}\,d$, usually. If $l_1 = d$, $c = \frac{1}{4}\,d$.

$e = \sqrt{\frac{L\,W}{g\,f} + r^2} - r$, in which $W = \frac{\pi\,D^2}{4}\,p_1\,\frac{\sqrt{n^2+1}}{n}$.

$D$ = diameter of cylinder; $p_1$ = maximum pressure on piston in pounds per square inch.

$n$ = length of connecting rod ÷ length of crank. $\frac{\sqrt{n^2+1}}{n}$ is the secant of the angle of the rod with the center line of the engine.

$g = 2\ r$, usually, in which case $e$ = about $\frac{1}{3}\ r$.

The thickness of the crank $a$, parallel to the axes of the shaft and pin, is generally made constant and = $\frac{4}{5}$ of the shaft diameter. It may, however, be determined by limiting the value of the breadth, $b$, at the widest part. This limiting value is usually $4\ a$, so that $a = \sqrt[3]{\frac{W\ L}{30}}$

and $b = .01\sqrt{\frac{W}{a}}\ x$,

$x$ being the distance from the center of the crank-pin to the point at which $b$ is measured.

DIMENSIONS OF CRANK ARMS.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Diam. of cylinder, ins. | .... | 10 | .... | ... | 30 | ..... | ..... | 50 | ..... |
| Stroke, $S$, ins | 12 | .... | 24 | 30 | .... | 60 | 48 | .... | 96 |
| Max. pressure on pin $P$. (approx.) lbs. | ... | 7,854 | .... | .... | 70,686 | ..... | ..... | 196,350 | ..... |
| Diam. crank-pin = $d$ | 2.10 | .... | 2.10 | 7 34 | .... | 5.58 | 12.40 | .... | 8.87 |
| Diam. shaft, $a\sqrt[3]{\frac{I.H.P.}{R}}$ ..... D | 2.74 | .... | 3.46 | 7.70 | .. | 9.70 | 12.55 | .... | 15 82 |
| ($R$ = 4.69, 5.09 and 5.22) | .... | | .... | | | | | | |
| Length of boss | 8 D | 2.19 | .... | 2.77 | 6.16 | .... | 7.76 | 10 04 | .... | 12.65 |
| Thickness of boss | 4 D | 1.10 | .... | 1.39 | 3 08 | .... | 3.88 | 5 02 | .... | 6 32 |
| Diam. of boss | 1.8 D | 4.93 | .... | 6.23 | 18.86 | .... | 17 46 | 22.59 | .... | 28.47 |
| Length of crank-pin eye | 8 d | 1.76 | .... | 1 76 | 5.87 | .... | 4 46 | 9.92 | .... | 7 10 |
| Thickness of crank-pin eye | 4 d | .88 | .... | .88 | 2 94 | ... | 2 23 | 4.46 | .... | 3.55 |
| Maximum moment, $T$, at distance $\frac{1}{2}\ S - \frac{1}{2}\ D$ from center of pin, inch-lbs | | 37,149 | .... | 80,661 | 788,149 | .... | 1,848,439 | 3,479 322 | .... | 7,871.671 |
| Thickness of crank arm $a = .75\ D$ | | 2.05 | .... | 2 60 | 5.78 | .... | 7.28 | 9.41 | ... | 11.87 |
| Greatest breadth, $b = \sqrt{\frac{6\ T}{9000\ a}}$ | | 3.48 | .... | 4.55 | 9 54 | .... | 13.0 | 15.7 | ... | 21 0 |
| Minimum moment, $T_o$, at distance $d$ from center of pin = $P\ d$ | | 16,493 | .... | 16,493 | 528,835 | .... | 394,423 | 2,434,740 | .... | 1,741,625 |
| Least breadth, $b_1 = \sqrt{\frac{6\ T_o}{9000\ a}}$ | ..... | 2.32 | .... | 2 06 | 7.81 | .... | 6 01 | 13 13 | .... | 9.89 |

Thurston says: The empirical proportions adopted by builders will commonly be found to fall well within the calculated safe margin, as above. These proportions are, as obtained from the practice of successful designers, about as follows:

For the wrought iron crank, the hub is 1.75 to 1.8 the least diameter of that part of the shaft carrying full load; the eye is 2 0 to 2.25 times the diameter of the inserted portion of the pin, and their depths are, for the hub, 1 0 to 1.2 the diameter of shaft, and for the eye, 1.25 to 1.5 the diameter of pin. The web is made 0.7 to 0.75 the width of adjacent hub or eye, and is given a depth of 0.5 to 0.6 that of adjacent hub or eye.

For the cast-iron crank, the hub and eye are a little larger, ranging in diameter respectively from 1.8 to 2 and from 2 to 2.2 times the diameters of shaft and pin. The flanges are made at either ends of nearly the full depth of hub or eye. Cast-iron has, however, fallen very generally into disuse.

The crank shaft is usually enlarged at the seat of the crank to about 1.1 its diameter at the journal. The size should be nicely adjusted to allow for the shrinkage or forcing on of the crank. A difference of diameter of one-fifth of one per cent., 0 998 to 1. will usually suffice; and a common rule of practice gives an allowance of but one-half of this, or 0.001.

The formulæ given by different writers for crank arms practically agree, since they all consider the crank as a beam loaded at one end and fixed at the other. The relation of breadth to thickness may vary according to the taste of the designer. Calculated dimensions for our six engines are as given above.

## Cheap Labor.

The Italian laborers who are grading the proposed Lehigh Valley freight yards at the foot of Chapel avenue live in a dilapidated old barn that stands beside the canal. The place is a disgrace to the community. They sleep huddled together on the floor and on the hay loft. The place reeks with filth. They cook their meals over bonfires made in little holes dug in the earth. The space surrounding the stable is full of these fire pots. They eat anything they can find. A *Journal* reporter saw them at work getting their supper recently. Some of them were catching minnows from the canal, others were cooking those already caught. Minnows and bread composed their meal. —*The Evening Journal* (Jersey City).

What one can always say about the trolley cars—one more killed.

## The Use and Abuse of Gauge Cocks.

BY W. H. WAKEMAN.

We frequently come in contact with engineers who apparently do not have well defined ideas as to the object in putting gauge cocks on a boiler. Some seem to think that they are for ornament only, and as they are made of brass and nickel plated, they keep them in good order on the outside, but if they are compelled to open them for any reason, they are found to be stopped up with mud and sediment, and when they are cleaned out the result is that the boiler front is so bespattered with mud, that it takes the boiler attendant about half an hour to clean it up, and he resolves not to repeat the operation if it can be avoided. This is all wrong, for the gauge cocks on a boiler should be used every day, and at such intervals as will keep them free from sediment, so that when they are opened, they will leave no stain on the boiler front.

The writer once took charge of a plant where the gauge cocks were regarded as ornaments only. After they had all been opened, the boiler fronts were a sight to behold. They were opened at short intervals with less and less disastrous effect on the shining black fronts, but they did not fail to leave their footprints behind them, until the boilers were thoroughly cleaned. This was done at the first opportunity, when the cocks were removed, the pipes connecting them to the boilers were thoroughly cleaned out by means of an iron rod forced through them, after which the nozzle of a hose pipe was inserted, and water forced through them, until they were thoroughly cleaned.

I operated those boilers for five years afterwards, and at no time would they leave more than a slight stain on the boiler fronts, and even when this was noticed, it was always considered good evidence that it was time to clean boilers. I am aware that there are many places where this could not be done so easily, but in a very large majority of cases, gauge cocks are dirty, because they are neglected. If the water is bad, they need to be used more, for, as a rule, continued use of them will keep them clean. Sometimes engineers dislike to open them, because they will not close tightly afterward, so that it becomes necessary to repack them. Instead of this being an argument in favor of neglecting them, it is in reality in favor of their more frequent use, for after careful observation of the results of practice, we find that if a gauge cock remains unopened for a long time, it is almost sure to leak when it is disturbed, and that frequent use of these useful attachments does not make it necessary to put in new packing any more often on this account.

There are many varieties of gauge cocks in the market at the present time, but comparatively few are worthy of being called good ones. A friend who was in search of the best one made, was shown a sample of a new kind which was highly recommended. He examined it, and expressed the idea that it would stick to its seat in a short time. One of them was applied to one of his boilers for trial. When first applied it was all that could be desired. Soon afterward it was found stuck fast to its seat, and this trouble became chronic with it. In order to know definitely its value as an indicator of the amount of water in the boiler, it was thoroughly blown out, and in two hours afterward it was found to be stuck fast to its seat. It was again blown out, and put on probation for 15 minutes less than before, and this was continued, each period of trial being 15 minutes less than its predecessor, until the time was reduced to 15 minutes, and when it would not keep free for this length of time it was condemned.

When a gauge cock is opened for the purpose of ascertaining where the water level is in a boiler, it should be kept open long enough to allow any water that may be standing in the pipe to be blown out, for where each cock is connected by a separate pipe which may be 18 inches long, if it is opened slightly and instantly closed, it may show water which is only condensed steam standing in the pipe, and in no wise be a true indication of what is in the boiler. This cannot happen where the cock is screwed directly into a water column, as the passage is too short to allow it.

Where the connection is made directly into the boiler, the cock should have a straight passage, so that if it gets clogged up, the ball may be raised and a wire run in to clear it out, while under steam pressure, but if a water column is used, the valves in the connecting pipes may be closed at almost any time for a few minutes, and the cock cleaned or repaired. If a gauge cock commences to leak, it should not be forced to its seat in an effort to stop it, but it should first be opened for a few seconds, as a piece of scale or dirt of some kind may be the cause of the trouble, and this may be blown out by judicious management.

"Two men boarded the train at Osage City, and took a seat in the smoker, just in front of me," said a traveler to a *Globe-Democrat* reporter. "It was evident from their conversation, which was carried on in quite a loud tone, that they were, both of them, in hard luck, and were going to Topeka in search of employment. One of them placed his ticket on the seat, while he lit a very inferior cigar, and his companion quickly picked it up and put it in his pocket. A few minutes later the man missed his ticket, and went through the usual pantomime of turning out all his pockets and looking in his hat lining. Knowing the conductor would be round in a moment, and also that he had not enough money in his pocket to pay his fare again, he began asking the advice of his friend, who suggested gravely that he crawl under the seat and try to escape notice that way. There seemed no other alternative for the unfortunate man, who cramped himself under the seat as suggested. When the conductor came along the practical joker handed him two tickets, and was, of course, asked who the second one was for. He replied that it was for his friend, who preferred riding under the seat, whereupon the victim of the joke crawled out, and amid general laughter knocked the dust off his clothes and promised to break in his friend's head on the first opportunity."

As an evidence of the reason why farm laborers desire to get to the cities, a daily paper makes note of a man, who after 54 years faithful service as a workman on a farm, finds himself discharged on account of old age, and sent to the poorhouse. Suppose he had come to the city, Brooklyn, for instance, and worked as trackman for $1.25 per day, which is the price paid by the street railway companies there, is it likely he would have been any better off?"

Sometimes people will get down to common sense. A motorman of the Union Trolley Company, of New York, was recently brought up before the court, as usual, for injuring a street passenger, when upon second thought the charge against him was withdrawn and a suit against the company begun. This was a sensible thing to do.

## Another Fly Wheel Accident.

BY PETER H. BULLOCK.

Another pair of engines in one of the large cotton mills in the Merrimack Valley has been wrecked by an accident very similar to that at the Amoskeag mills some two years ago.

On Friday, August 10th, at 2 30 P. M., the 30-foot fly wheel of a pair of Harris-Corliss engines was wrecked, and considerable damage done to the mill, but not so much as would have been the case had some of the *debris* been deflected either to the right or left, as a section directly over the wheel was supported by four iron columns between which the wheel ran. Fortunately, these were not disturbed, but the woodwork between them was torn away, as well as the wall to the rear, which was cut down in a narrow section nearly as straight as if done on purpose by masons. Pieces thrown in the opposite direction went through a window, scarcely disturbing the wall, the path of the flying pieces being hardly wider than the face of the wheel, and the general wreck considerably less than in the case of several other fly wheel accidents that have been visited by the writer.

The plant belongs to the Nashua Manufacturing Co., and the engines are a pair of 30x60 simple condensing, running 61 revolutions. The governor was not provided with any stop motion, but had a Collimore isochronal attachment. The power was transmitted to a jack shaft in the basement of the mill by twin belts from the fly wheel, which had single arms, but not nearly so wide a face as the Amoskeag wheel. I have not the measurements of the cross-section of the arms, but the Nashua wheel seemed lighter than the other, but the quality of the iron was far superior. In fact, I did not discover any defects in the fragments examined.

Fortunately, in this case, there is no doubt as to the cause of the disaster, and anybody else having an engine with the same factors of accident can take immediate means to avert a like occurrence.

The governor was belted in the usual way directly from the main shaft to the driving shaft, which in turn was connected by bevel gears to the vertical spindle to which the balls were attached. The gear on the spindle was secured by a taper pin about $\frac{5}{8} \times 1\frac{5}{8}$, and perhaps 3 inches long. This pin became loosened and dropped out, letting the governor spindle stop revolving, and, of course, admitting steam the full capacity to which the valve setting may have been adjusted. It seems to be an undisputed fact that the speed in the weave rooms went up to a point that would represent 75 to 80 revolutions of the engine before the crash came.

The attendant was quite near the engine, and asserts that he knew of nothing wrong until the wheel began to go to pieces, and he then, believing that absence of body was better than presence of mind, did a very creditable piece of sprinting towards the boiler house, which, by the way, is located some 1,500 feet away from this engine, to shut off the 16-inch main supply pipe, which had been broken, and was pouring steam into the mill.

It seems almost incredible that a person as familiar with an engine and its regular sounds as an engineer should be, could have failed to notice such an acceleration of speed as there must have been in this case. There may be some doubt whether the attendant would have been able to have closed both of the 9-inch throttles before the wheel went to pieces even had he been right on the spot, yet I believe there are a good many men who would have noticed the stoppage of the governor, and found a way to have prevented the accident. Each engine, for instance, could have been unhooked easily, as they were fitted with a lever lifting and detaching apparatus to the valve motion.

Superintendent Manning was summoned from the Amoskeag Co., at Manchester, and

it was decided to have him build a wooden wheel like the one built by him to replace the one wrecked at his mill.

This accident seems to me to prove that a wheel of even good material will go to pieces at a speed considerably below what experts have usually given as their holding limit, and that the factor of speed safety for large cast-iron wheels has been too low.

### Triple-belt Pulley.

We illustrate herewith a new form of pulley, designed especially for the heaviest service, such as where triple belts are used, it being so constructed as to obviate the well-known difficulties arising from unequal shrinkage in a solid pulley.

To this end each arm is made independent of all the others at the center, and they are finally clamped solidly together by means of the threaded sleeve which passes through the hub, and has, at each end, the internally threaded collars. Of these collars the one seen at the left has two locking recesses formed in it, which engage with corres ponding projections upon the pulley. This is first screwed onto the sleeve which is then passed through the hub and the other sleeve is screwed upon it and made tight, binding the whole solidly together. The set screws then prevent the possibility of things coming loose.

Made in this way, a pulley can, if desired, have a heavy rib inside the rim, as shown, greatly strengthening it either for heavy service or for very high speeds, and in short, it may be made of any desired form, as indicated by the duty it has to perform, without regard to initial strains, caused by shrinkage. The pulleys are made by James Yocom & Son, Shafting Works, 123 Drinker street, Philadelphia, Pa.

### Cast-steel Propeller.

The accompanying illustration shows a cast-steel propeller 10 feet diameter, and 13 feet mean pitch, of the patented sectional dovetail type, made by the Dry Dock Iron Co., Bay City, Mich. The peculiar feature of this wheel is the screw-shaped hub, and the manner in which the blades are fastened to the hub, namely, by means of carefully fitted dovetail joints driven home by steel keys. The advantages claimed for this wheel are: A saving of weight of about 15 per cent. over the ordinary sectional cast-iron propeller; less resistance on account of screw-shaped hub and thinner cutting edges of blades, and greater strength obtained by the use of homogeneous cast steel, having almost twice the power of resistance against sudden shocks as compared with cast-iron. This last feature will be appreciated by owners of vessels navigating the Great Lakes and rivers, in which logs and other obstructions are frequently met with. It is claimed that this propeller is doing excellent work.

"It isn't commonly understood that there are graduates from colleges who are horse-car conductors in this town, but I discovered one such," said a well-known clergyman. "I was on car 91 on the Madison avenue line not long ago, and on the upper end of the route only the conductor and I were in the car. He sat down, took out a book, and began reading at the end of the book, and turning the leaves from right to left. "That must be Hebrew he's reading," I said to myself. The conductor seemed mightily interested in the subject, and he nodded his head approvingly and occasionally chuckled when the author had made a good point. Finally I went over to his side and said:

"Excuse me, but are you reading Hebrew?"

The conductor nodded.

"Are you a college graduate?" I asked. Another nod.

"What college?"

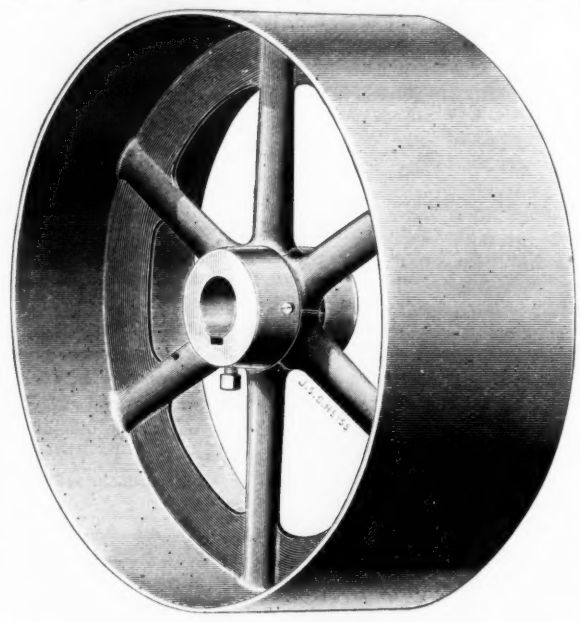
"'85—Yale."

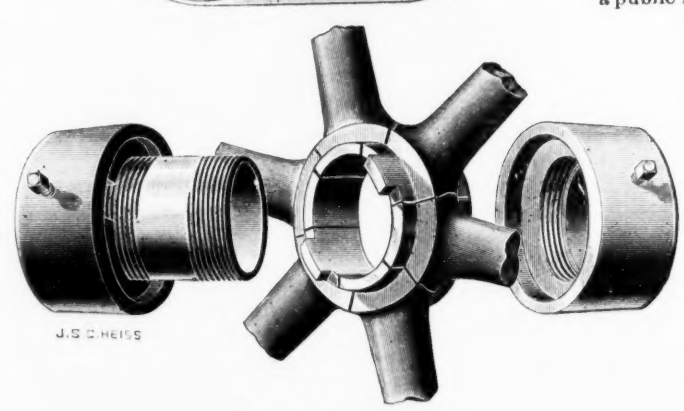
"Then he resumed his reading, and I asked no more questions."—*The Sun.*

## Mechanical Stoking.

By W. H. Booth.

Quite apart from the complication and imperfections of the earlier types of mechanical stokers there were other causes that have assisted to hinder the *adoption* of machine stoking. It seems to be a fact that so far the greatest amount of duty can be obtained from a boiler which is fired on the sprinkling system, and the earlier mechanical stokers were constructed upon this principle and either through the agency of rapidly revolving fans or spring actuated shovels sprinkled small coal all over the surface of the fire. Some of these had also moving bars which had a slow movement either to the front or back end of the furnace for purposes of removal of ash and clinker.

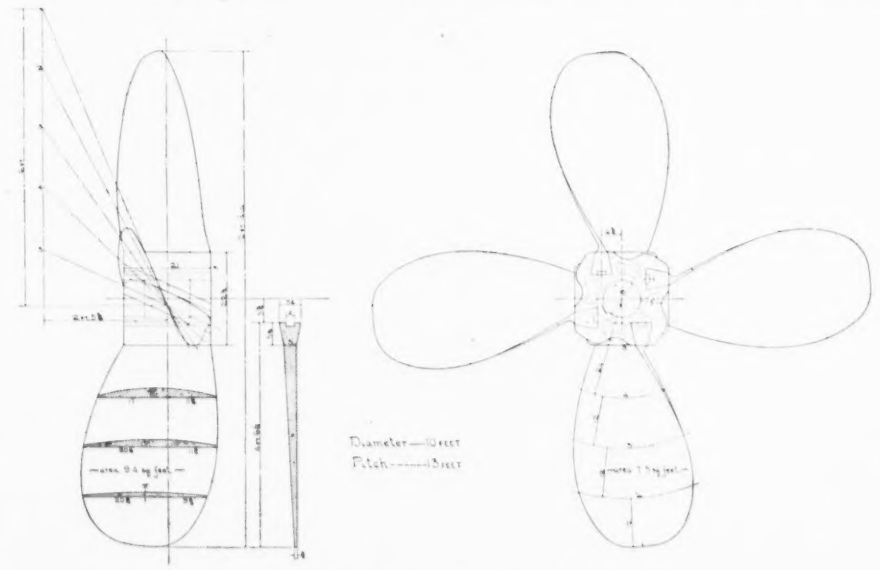




Triple-belt Pulley.

In one of these machines that bid fair at one time to be a great success the whole of the fuel was thrown right to the back end of the furnace against the bridge except such smaller particles as fell short by reason of their lightness. The grate in this case was simply of the link belt type—a continuous hand of jointed short pin connected bars, and it delivered all the ash and clinker into a box at the furnace mouth. Any residual heat in the refuse was carried back by the draught into the furnace, and in such examples as I saw at work there appeared to be very little wanting to make this machine perfect. The coal as it fell against the bridge became coked by the heat of the gases passing over it and the hydrocarbon gases were consumed, and the machine was an improvement upon those which sprinkled the coal over the whole surface of the fire, and which though, perhaps, not showing at any time much smoke kept up a steady light smoke all day, which in the aggregate was considerable. But after all the above stoker failed for the same reason that all sprinkling stokers must fail unless they are supplied with coal so wet as to reduce the dust to a condition of paste—wet enough in fact to stick together in fair sized masses during the flight from the spring shovel to the fire surface. Unless so wetted the fine dust never touched the fuel on the grate, but was carried by the draught more or less consumed over the bridge and into the flues where it partly deposited, while the lighter particles often partially coked and thus spongy and of little weight were carried out at the chimney top, and became a public nuisance over a wide area round that chimney, choking rain-water gutters on house tops and gritting everything.

This effect of the sprinkling system rendered it necessary either to evaporate a lot of otherwise unnecessary water in the furnace or to abolish the system, for there would not usually be even space available on which to construct a chamber to act, like the stive room of the corn miller, as a depositing chamber for the dust. This trouble has had much to do with the favor in which stokers of the coking type are now held. In these the fuel is simply pushed upon the ends of the bars or rather upon a dead plate under which the bar ends extend and each fresh push of fuel pushes the previous amount forward and finally upon the bars which carry the coking mass slowly to the bridge end of the furnace where all that is left tumbles over the ends of the bars into the space left between the grate and the bridge wall, and if still combustible it there burns away. For under-fired boilers one form of machine stoker was very efficient. The furnace was carried upon a wheeled frame and the grate had a width of as much as five feet and was of the link belt type. The carriage projected outside the furnace and coal was placed on the outer end of the traveling grate and strickled down to an even thickness by a plate under which it had to pass. Magnificent fires were obtained by this means, but the boiler insurance companies in England discountenance externally fired shell boilers, and this furnace cannot be so well applied to flue furnaces, though it is eminently suitable for the wide furnaces of water-tube boilers. In all coking stokers it is well to have a brick arching over the coking fuel on the dead plate, and this could very well be applied to the underfired boilers.




Cast steel Propeller.

This mechanical stoker involved no extraordinary labor from the boiler attendants in the way of lifting coal more than ordinary firing. In fact, the labor was less for the coal, only needed placing thickly enough upon the grate, and it was automatically levelled and the grate was low down and the labor a minimum and quite unskilled in this respect. With internally fired boilers, however, all is different. The grate is not low down and is fed from a hopper high up above the fireman's head, and there can be little doubt but that the extra labor and the dirt and dust involved in filling those elevated hoppers did much to condemn mechanical stoking all round. Now, however, it is becoming common to add coal elevators to raise the coal into the hoppers and mechanical stoking on the coking system bids fair to become very common. It is a little curious to reflect that the coking system now becoming recognized as correct is simply the system of 100 years ago. Indeed, did not James Watt describe how to fire a boiler, and is it not a fact that the dead plates in old times were of large size and held a lot of coal? In the old times the furnaces of boilers had no doors. The only door was the heap of green fuel piled on the dead plate until it touched the arch above it. This door remained until it was coked and flames appeared on its outer face when it was pushed back and spread upon the fire and a new door thrown up. I have at least once seen such doors as this; it was at a colliery where externally fired cylinder boilers of the old egg-ended type were used and the fuel was the rubbish not supposed to be saleable, and so it was used up at the pit itself.

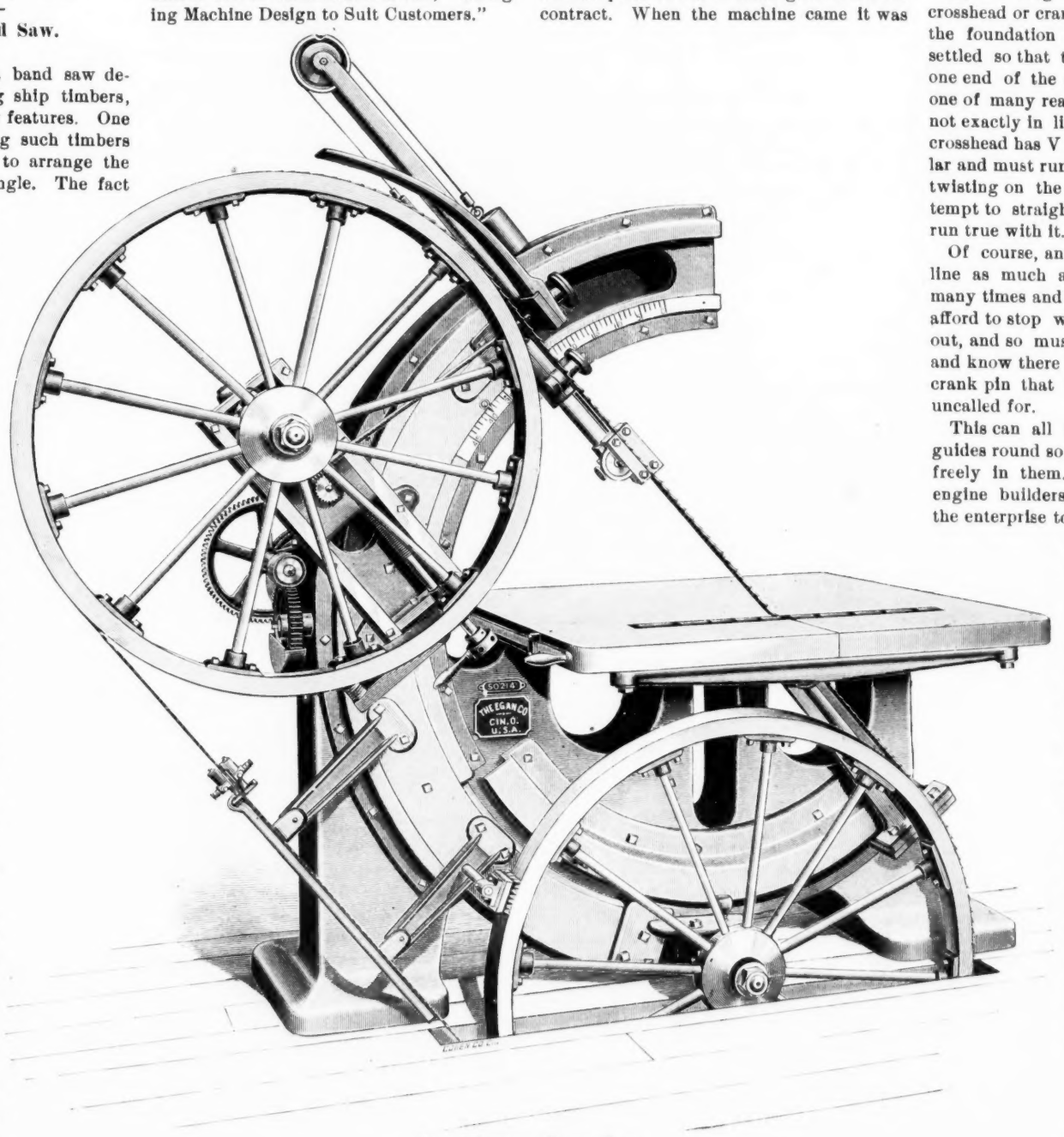
There are many of us in this country who years ago condemned the use of mechanical stokers where these involved the filling of elevated hoppers with dusty coal. Frequently this operation could only be done backward over the shoulder, and it was only human nature that failure resulted and breakdowns—accidental or otherwise—occurred frequently, and the machines were condemned, simply from the inability of the inventors to recognize plain facts. There ought not really to be any coal upon the floor of a boiler house. The coal should come in from a coal room along a conveyor trough to each hopper, entering quietly and without dust. In the coal room there should be a machine to crush large coal to a smaller size, for it may happen that if a supply of small coal is accidentally cut short and only round coal is obtainable, the stoking machines cannot deal with this latter. Mechanical stoking is gaining much in favor here from the fact that it deals so well with small bituminous coal which is one of the cheapest of our fuels, and at present prices in London is securing an economy of as much as 50 per cent. in the cost of evaporating water, as compared with expensive smokeless coal which is the refuge of everyone here who does not know how to manage bituminous and smokey coals. The weakest point about mechanical stokers seems to me to be the liability of the admission of an excess of air through the parts of the grate where the fuel is becoming burned out. Some excess may be required to consume the hydrogen gases distilled from the green fuel, but there is still apt to be an excess beyond this, and in reading Mr. Roney's recent paper on "Mechanical Draft," read at Montreal, there appears to be an illustration of a system of mechanical stoking applied to externally fired boilers which is worth noting. The fire grate—probably a movable one—terminates over a pit placed below ground to re-

ceive clinker and ash, and it would appear that such pit being properly closed and air tight, no air could possibly enter in excess at the back end and an economy would thereby be secured. For internally fired boilers the same result is not so easy to secure, though for the larger sizes of furnace something of the sort may be possible, and for land purposes now, the improvements in boiler making and materials combined with the reliance now placed on steel as a material for large shells has led to the employment of pressures of 160 pounds in shell boilers of 8 feet 6 inches diameter, in which there are two furnaces of about 3 feet 6 inches diameter, the triple expansion engine now rapidly becoming the standard engine for factory purposes.

Ten years ago pressures of 100 pounds were looked on as high, but now shell boilers have been made to go as high as 200 or even 250 pounds for stationary work.

### Ship Timber Band Saw.

We illustrate herewith a band saw designed especially for sawing ship timbers, which possesses several new features. One of the older plans for sawing such timbers at the required angles was to arrange the table to tilt to any desired angle. The fact that where different angles had to be sawn upon the same piece it was awkward to change the adjustment of the table with the heavy timber upon it, aside from the fact that it was difficult to guide a heavy timber upon an inclined surface, led to the adoption of the plan of arranging the upper wheel to move upon the arc of a circle, the center of which was the axis of the lower wheel. This changed the position of the saw where it passed through the table, and to avoid this difficulty, the present machine is arranged so that both wheels move to change the angle, the center of the arc upon which they move being the point in the top of the table at which the saw passes through it, and thus this position remains the same, or, in other words, the saw passes through the table at the same point, regardless of the angle to which it is set.




Ship Timber Band Saw.

The frame of the machine is a solid casting of cored section in which a circular seat is turned, to which is fitted the carriage carrying the wheel supports and accompanying mechanism.

Provision is made for regulating the tension of the saw (which, of course, remains constant, regardless of angle), and the machine can be set to angle either by hand or power, a graduated scale indicating the angles. There are the usual anti friction guide rollers for the blade of the saw, and in the table there are a number of rollers which support the timber sufficiently to relieve its pressure upon the table and decrease friction.

The wheels are 48 inches diameter, 3¼ inches face; have wood rims and steel spokes. They are carefully balanced, and the guide post adjusts to any required distance from the table up to 24 inches. The machine is sent out with a 2-inch blade upon it, and weighs 5,600 pounds. It is made by The Egan Company, Cincinnati, Ohio.

The machinery house of George T. McLauthlin & Co., No. 120 Fulton street, Boston, Mass., inform us that considerable trouble and annoyance to them has arisen from similarity of names between theirs and another house, and they request their patrons to be particular in addressing them exactly as above, letter for letter.

## LETTERS FROM PRACTICAL MEN.

### Flies and Drawing Ink.

*Editor American Machinist:*

In your reply to W. M. M., Elgin, Ill., Question 358, August 2d issue, I believe you have made a slight mistake.

My experience with Higgins' inks is that the flies will attack the "general" ink, and on this account, although I prefer the "general" kind for general work, I use the "waterproof" during fly time.

A. S. Mallory.

### Changing Machine Designs.

*Editor American Machinist:*

Mr. Walter B. Snow brings up a subject that is full of reminiscences, viz., "Changing Machine Design to Suit Customers."

There are many sides to this, and one thing a customer should look out for is that the general design should not be changed if it can possibly be avoided, as repairs are important, and any material change might make trouble in the future.

Some years ago the writer wanted a change made in a Corliss type of engine, but the builder refused to make it. After an interval of a few years he agreed to it.

The change paid about 200 per cent. profit on actual cost.

The superintendent took the results to the draftsman, and after commenting on them for a time, the superintendent ventured the information that Mr. C. had wanted that change made for the last three years.

Being asked why he had not made it at once, he replied that they "did not want outsiders to come there and tell them how to build engines."

Another builder absolutely refused to make the change, but after some ten years when there was a large engine called for, and was told that he could have nothing to do with it unless it was built that way, replied that they were ready to build it as we wanted it, and added, "Mr. Crane, I believe the day for being pig-headed and insisting that we know it all is gone by. Some one is going to build this machine as you want it, and we might just as well do it as have some else."

The only trouble is, if a builder does not want to make a machine as the customer wants it, he should say so before taking the contract, and this some of them do not do, but take the contract, and then build the machine as they please.

The writer recently wrote up some specifications for a machine. This machine was being built perfectly satisfactory by one party, but other parties wanted to bid on it, and the price of one of these gave them the contract. When the machine came it was nothing like that called for, and when notified, they said that they begged to differ with the writer of the specifications, that their construction was much superior.

They were informed they could take their machine away. They then wanted the privilege of re-building as called for. This was done, but was a source of delay and expense to the buyer, and not a great deal of fun for the builder.

On the same job a fitting was called for, and as the writer's experience corresponded with "Dick's," it was specified that they should be according to "Dick's" standard. The contractor, however, bought them of "Tom," and "Tom" made them different. When the fittings were rejected, "Tom" was very indignant, and felt very much aggrieved, and thought we were unreasonably exacting, and to settle the matter said: "We have furnished you a standard fitting, and yet you are not satisfied." He was told that he had furnished "Tom's" standard, while the specifications called for "Dick's" standard.

A purchaser after carefully looking over the field decides what he wants to use, and specifies just what he wants, but there are many competitors and they all want a chance, and so long as they can put in a bid and do the job just as they choose, everything is lovely, but if they are held to the purchaser's wants, they insist that the purchaser or his adviser is an idiot, and that their standard is correct.

When a purchaser makes up his mind what he wants, he should insist upon it. If one party will not build it, he will find some one who will. Also, after he has contracted to have it built a certain way, he should insist on its being built that way.

There are many cases where engineers have an engine that pounds. All keying up only makes the matter worse.

After a long search it is found that the crosshead or crank is not in exactly true, or the foundation was not just right, or has settled so that the cylinder has tipped, or one end of the shaft is a little low, or for one of many reasons the connecting rod is not exactly in line with the crosshead; the crosshead has V guides, or something similar and must run true, at the same time is twisting on the crank pin in the vain attempt to straighten everything else out to run true with it.

Of course, an engine should be kept in line as much as possible, but there are many times and conditions that one cannot afford to stop when something gets a little out, and so must put up with the pound and know there is a strain being put on the crank pin that is entirely unnecessary and uncalled for.

This can all be remedied by making the guides round so that the crosshead will turn freely in them. There are three or four engine builders in the country who have the enterprise to build engines with bored guides. To the others it means quite an item.

For most builders it means an outlay of from $10,000 to $20,000 to change over from the V, flat or oval guide, but that is not the purchaser's fault, and other parts being as good, builders should not find fault if purchasers should decide to buy where they get what they want.

These matters, however, adjust themselves, as if manufacturers do not cater to the market they find themselves out of business. The public usually know a good thing when they see it and understand it, and he that anticipates the wants of consumers is the party that gets the business.

Waterbury, Conn. W. E. Crane.

### Compressed Air Superstitions.

*Editor American Machinist:*

There would seem to be a plenty of work yet for the compressed air missionary, and he can probably do it in no way more effectually than by keeping right on telling the truth. There is that superstition about the mysterious losses and disappearances of compressed air, mentioned by "Quirk," July 12th, and referred to in reply by me, July 26th, and now it comes up again, August 2d, in Mr. Hobart's letter about fire engines. There are no "mysterious disappearances" of compressed air, and there are no losses through leakage that are not as easily preventible as steam leakages, and by the same means. The power losses through the cooling of the air after compression are sufficiently well known, and need not now be alluded to.

But now, August 2d, Mr. Hobart brings up another of the superstitions about compressed air. He says: "Use that cylinder full of highly compressed air and it will

freeze up cylinder, valve, and, perhaps, engineer, too, if the air is not heated before being used."

A great many compressed air locomotives, probably hundreds, are constantly used, in mines and elsewhere, without any reheating of the air and without freezing up, and the makers of the locomotives will absolutely guarantee to do it every time. Rock drills by the thousand and pumps and hoisting engines without number are run by compressed air without reheating it and without freezing up.

What may not be as well known is that compressed air is now superseding direct steam upon what may be said to be its own ground. Stone quarries and extensive engineering works, employing machinery distributed over considerable distances, and requiring frequent change of location, are now equipped with a central compressed air plant, and the machines are driven by the compressed air, and they are found to be operated more cheaply than by steam. I have heard of no instance of reheating the air in this service, and I have not heard of any frozen engineers. The Chicago Drainage Canal, one of the greatest engineering works in the world's history, now has hundreds of engines of various kinds developing thousands of horse power, driven by compressed air used without reheating.

Frank Richards.

### Fire Engines.

*Editor American Machinist:*

I notice a great deal of attention is being given of late in relation to motors for fire pumps. Now, we know that the heaviest of fires are likely to occur in cities and towns in the coldest weather, at a time when hydrants are most likely to be frozen, and a fire engine that could not quickly supply steam to thaw out frozen hydrants would lack one of its most important features. No makeshift arrangement will do. There must be the most ample means ready for use *at once*, for at the beginning of a fire the loss of time is the most disastrous in its final results.

Then the fire may be in the outskirts and there may be a bursted water main; the engine must go for water wherever it is to be had without reference to electric lines or anything else.

There may be several engines at work on a single circuit; a simple accident may throw them all out of service. In fire service no risks must be taken that can be avoided. An apparatus must be capable of working anywhere, independent of everything but itself.

To sum it up, when you take from a fire engine the steam hose for thawing purposes, and a pair of horses that will go wherever there is an opening, you have taken away from it what cannot be spared in

Troy.

### Removing Cranks.

*Editor American Machinist:*

I have noticed lately a good many articles in the American Machinist about the taking off of crank disks, cranks, flanges, etc., that resisted ordinary methods. With us in this city, such a job is very common, on account of the large number of river steamers, and the fact that they are all sternwheelers. These boats are used for all purposes, from first class passengers exclusively to towing grain laden ships in and up and down the river, and consequently a broken shaft is no unusual occurrence. The cranks are nearly always wrought-iron, and are shrunk and keyed on. When we have to take them off, the key is first knocked out, that is, if a good blacksmith helper with a 30 pound sledge can start it; if not, that usually makes no difference, and it is left in till later. The method usually followed is this: A tripod, carrying chain blocks is set up over one crank, and is hitched on the pin by a rope sling. A box is built around the crank base, so that it is filled with sand, in such a way that the shaft is covered over with the sand, and a space left around the crank that will hold about the weight of the crank of cast-iron. Then melted iron is poured in the space, and left to cool just long enough that it will not run, then the box is broken away, the key knocked out, a strain taken on the chain blocks, and the crank is pushed off by hand, with a stick of wood. Then the other end of the shaft receives the same treatment, and the job is done, taking usually an hour or two without any laborious work.

Sometimes the foundry is not running, and we want a crank off. In this case a fire of cord wood is built around both cranks at the same time, and crank and shaft are both made hot together—just hot enough to begin to show red, when the fires are torn down, and a stream from a hose turned on the crank, taking care to keep the stream off of the shaft for a few minutes. After they have been cooled, the crank will be about $\frac{1}{32}$ inch loose on the shaft. Of course, this makes no difference, as the new shaft has to be turned anyhow, and it can be fitted to the crank.

Portland, Ore. C. W. Scott.

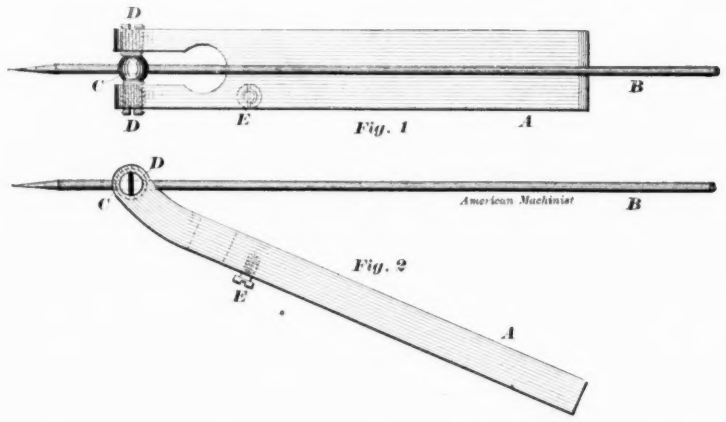
### Stuck for Postage.

*Editor American Machinist:*

Under this heading I note in your issue of July 26th, a complaint against an English firm for mulcting your client in deficient postage. It seems a convenient opportunity for a *tu quoque* retort. Day after day the commercial public here is called upon to pay fines, because the idea in the States seems to be that 2 cents, which is good enough for them, is good enough for Britishers. May I remind your readers, many of whom are in my debt on this score, that the postage is 5 cents, not 2.

Hans Renold.

Manchester, England.




### A Center Indicator.

*Editor American Machinist:*

I have used a variety of indicators for setting a center point on work true on face plate or in chuck on lathe. The sketch I send you is very much simpler than the most of those commonly used, and yet it embodies all of the requirements of a center indicator.

*A* is the holder which is ordinarily held in tool post, and is cut out at one end as seen in Fig. 1. *B* is the indicator rod pointed at each end, and is provided with a ball *C* near to one end. *D D* are two screws in holder *A* cupped out to fit the ball *C* on rod *B*. The holes for *D D* in *A* should be carefully tapped out in line with each other, and the screws *D D* also should be cupped out true with screw and should fit holder *A* rather tight, so that they remain, when set to ball correctly. The one I have works satisfactorily; indeed, I question whether the more complicated ones work as well, or are so handy and reliable.

You will observe that Fig. 2 shows the end cut out to receive rod *B* is curved for the purpose that when not in use the rod *B* is laid parallel with holder *A* and can be kept in the tool chest without occupying too much valuable room.

When the proportion of long and short ends are made 10 inches to 1 inch then it follows that when the indicator point (long end) shows an oscillation of .01 inch the center point is within .001 inch of true.

This tool is provided with an additional piece fastened by screw *E* by which holes can be reset on face plate true, or the outside of a disk can be indicated, or any other convenient fixture attached.

Francis W. Clough.

Springfield, Mass.

### Altering Machines to Suit Customers.

*Editor American Machinist:*

Altering machines to suit customers, or altering machines for any purpose, is one of the difficult problems that stares a manufacturer in the face whether he is carrying on business for making money, or for the pleasure he takes in it, or the honor he hopes to get from it. In a stock company all the stockholder's interest (outside the manager) is pretty nearly that of dividends, and in looking forward to the paying of dividends the manager has to consider the question as to both the immediate outcome of a change and the future success of the concern. To make a thing one way or another the difference in the cost is apparent on the face of it, but to change a thing when once established as a regular manufacturer is not only twice as costly—if not five or ten times as costly—as it appears, and continues a source of expense as long as the industry and its product survive.

A manager knowing this hesitates to change under all circumstances, and hesitates about five years too long after he knows the change will make the machine or tool better, in fact, many hesitate so long that the first thing they know they have lost their trade and gone into bankruptcy. From this it is safe to reason that when it is fully established that a change is desirable and must be made some time, to keep up with the best, then the sooner that change is made the better.

As a case in evidence, forty years ago in an inland town there was built a machine, practically identical in mechanism with the most extensively used machine of the same kind to day. The design, architectural in embellishment, was characteristic at the time, fine cast iron patterns were fitted up and several hundred machines sold. More modern designs came into use, the old design grew to be unsightly, later repulsive, and then one of the things that modern mechanics would not buy, so a good trade was lost, and all because of those cast iron patterns, or back of that the courage or good sense on the part of the proprietors to throw them aside.

They were parties who were among the first to introduce looks in the "get up" of a machine; they had a design that never ceased to look correct and beautiful to them, and they would not change it to meet what seemed the ridiculous fancy or fashion of the times.

This is such a natural characteristic of designers that it may be many times to the interest of the stockholders to change designers or have the designer subordinate to the ruling head.

Just what to do to make the machine the best possible irrespective of selling price or making money (though the first and last usually go together) is another point that always bothers and sometimes trips up the designer. A case in point: Parties working for several years in building up an industry of the highest class of a special kind for a long time used steel castings for a certain part of the machine. It was a machine in which no one had ever been able to avoid accidents and breakdowns, and when such accidents and breakdowns did occur this special piece, though ample in strength for its legitimate work, would go with the rest, but was never the cause of the breakdown. Customers, never too willing to admit a fault on their own part, and the operator never making a mistake, always seeking for some defect in the machine, usually settled down to the steel casting, so after a time the builders, owing to protests from the users, and advice of mechanics, changed to a steel forging with this result:

Breakdowns continue as before, and while the average cost of repairs with the steel castings was about a hundred dollars in money and a heap of complaints, the average cost of the repairs with the forging for the same sort of breakdown is $400 and pay without a murmur. The forging does not break but makes scrap of many other more costly pieces. This leaves the builders of the machine in an unenviable predicament, and for two reasons. It tends to injure the reputation of the product and they cannot go back to the steel casting. Customers would not have a machine without the forged piece.

Invent safety devices that will prevent the breakdowns is the first thought, but that means another change, and the old customer says: "You ought to fix our machine that way for nothing."

There are other changes and some very desirable ones that are not so difficult. One change is of a class which may be used as an example; the change that would be necessary in adopting a standard size and taper for lathe centers.

The builder of lathes would have to have new reamers and possibly a new centering arbor depending on his method. The cost at the most would be slight, and it would neither modify design nor dictate material, and the new would not conflict with the old. Certain parties in Detroit propose to adopt "Jarno's" dimensions and tapers for lathe centers and call them "Jarno's" standard.

There is everything to recommend it as a standard, and all the reasons why standard sizes are desirable in screw threads and pipe flanges obtains in lathe centers and spindle sizes and threads. These are the times to promote the adoption of such an innovation, for the purchaser who wishes the standard has only to demand it, and the builder is not going to lose a sale because of a new reamer and two bits of steel.

These three diverse views of the question as to making changes to suit customers may confirm or change some manufactures and designers in their ideas, and it is hoped that of the many foremen and machinists who read this will give a moment's reflection to the fact that men who run a business have some things to lie awake nights over which they do not.

In this connection it may be well (now that the question of the proper way to treat workmen has received some ventilation) to make a suggestion. The idea has been broached many times that workmen would gladly accept a change to a day of eight hours for ten hours pay. These are elegant times now that manufacturers have a hard time to make both ends meet for the workmen to set the example and offer ten hours work for eight hours pay. Fearing that they are not likely to think of that the above hint is given, and doubting that even the best of them will accept it the following statement of fact is appended:

A concern well known to the writer, which is now only working short time and short handed furnishes power to a neighboring shop which keeps the power going ten hours.

This has given the men a good opportunity to work overtime for themselves and repair bicycles, make tools, fix up things around the house, etc., using the company's shop, power, tools and material at their own free will. This opportunity they have not been slow to avail themselves of, and yet with a hole half drilled or any little job half done they have quit at the sound of the whistle to change onto personal work, when in common fairness the men should have worked an hour for the company to balance

every hour they worked for themselves, for in the best of times shop power and tools cost as much as wages, and in bad times much more.

Of course, the reply to this will be that if a manager is fool enough to let the men have these privileges it is his own fault. True! but the point is how much better do the concerns feel who treat their men fairly than those who do not.

HOMER AVERY.

### Tool Room System.

*Editor American Machinist:*

I have noticed the articles on tool rooms in your late issues, and being a tool and gauge maker, have had some experience in tool rooms, both in large and small plants. The following is a system that I have found very satisfactory: In the first place, the man at the head of the tool room in a large or small plant should be a tool maker. In a large shop, where there are a number of contractors or different job departments, it will require most of the time of the tool maker to keep the tools in shape. In a small shop he can do the line of work required of a tool maker, and keep up the tools in the tool room. He should have tools of the necessary kind for doing the tool work, and keeping up the tools in the tool room so as to be close where he can deliver and receive tools at all times. Have the tools in racks, the racks divided into compartments for each tool. At the delivery and receiving window have a blank tablet printed in this form:

Name. J. SMART.

Contractor. WEST.

Then, when a tool is called for, write the name of the person getting the tool, and the contractor's name on the job he works on, tear off, and place in the division the tool is taken from. Then, if the tool is called for before it has been returned, one can see at a glance just where it is. The tool maker should inspect each tool as it is returned, and see it is in perfect order before putting back in division, so that it will be in order when next called for, or, if broken, duplicate it as soon as possible.

When the tool is returned, replace in the division for it, take the slip, and use again, if the parties want more tools, if not, deposit in the waste basket. A. E. BROWN.

Long Beach, Cal.

## Cogging a Mortise Gear.

BY JAMES F. HOBART.

A pair of cut steel gears, well designed and made, will work smoothly and almost noiselessly together, and theoretically indicate perfection in mechanical movement, but in right down hard every-day practice, a "cut" pinion, working into a cut mortise gear filled with wooden cogs, leaves nothing to be desired. But such perfection is seldom met with in mortise gears, or in their pinions. However, if the pinion is first-class, a very close approximation to the cut mortise gear is within reach of every mill man.

By "cut" gears it is understood that the teeth of the gear have either been cut from the solid, or dressed up after casting, by means of a milling cutter in a gear cutting machine. Not only can iron, steel, brass and wooden cogs be dressed in the gear cutting machine, but rawhide cogs can be shaped equally well. Rawhide cogs would work well, but they are expensive, and when it is decided to use rawhide and metal, for the cogs of a pair of gears, it is usual to cast, and perhaps cut, the gear teeth, then make the pinion of rawhide. The smaller piece is then composed of the more expensive material.

The owners of mortise gears usually buy cogs fully machined, all ready to drive and key into the gear. This method is a quick and cheap one, and a gear can be fixed up very quick by using it. But a gear thus filled does not always wear well. Machined cogs, Fig. 1, are perfect in shape, well finished, and all alike. But that is just where the trouble begins. (A mortise gear is made by putting up a pattern in sand, in the foundry, and pouring melted iron into the holes left by pulling the pattern out of the sand.) The mortises in the gear are formed by putting cores into the mold, and Fig. 2 shows how these cores sometimes effect the gear, particularly if the foundry men are careless about placing the cores.

At *a*, Fig. 2, is seen the effect of getting a core out of place. It has slipped sidewise a little, and the space is large at *b* and small at *c*. The effect of this, when fully machined cogs are to be used, is to make two teeth too close, and two more too far apart. The effect of spaces like these between cogs in a pair of running gears may easily be imagined. Look carefully at a mortise gear filled with ready-made cogs, and a few cogs can be found that have worn much more than the others, a few more cogs show hardly any wear. The worn ones correspond to the cogs situated like *a*, and one end of *d*. The unworn cogs are the ones at *e*, and end *f* of cog *d*

Cog *d* is twisted. The core got out of place a little, and the effect is as seen in the engraving. Sometimes the cores get twisted in another direction, so that while the top of the mortise is in exactly the right place, the bottom may have been pushed out of place. Such a thing cannot easily be detected by looking at the top of the gear, but just as soon as the finished cog is driven, then it becomes apparent. The bottom end of the cog being "out" in one direction throws the cog out in an opposite direction, the effect being the same as at *a*.

The remedy for the difficulty noted above is to put in cogs with blank teeth. Have only the body of the tooth machined, as shown by Fig. 3, the tooth to be dressed off after the cogs have been driven and keyed. In ordering "blank" machined cogs, they should have stock enough left on the body,

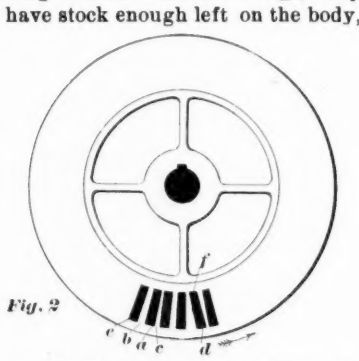


Fig. 2

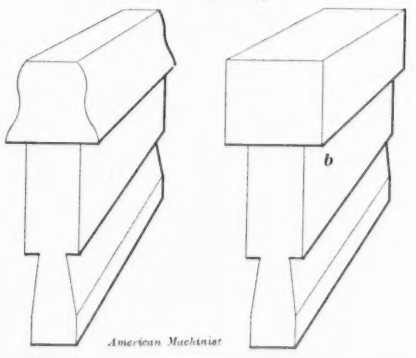


Fig. 1 Fig. 3

*b*, to allow of proper dressing, for if the cog does not fit snugly, and fill the mortise on all sides, that cog will not wear long. It will soon become what is known as a "springer." As the pinion strikes the loose ill fitting cog, it (the cog) is bent, or sprung over to the extent of the lost motion. Every time the gear revolves, this action takes place, and the rubbing of the cog against the mortise soon wears away the wood that comes in contact with the iron, making the bed fit worse, and the spring greater with every revolution of the gear.

Having procured suitable cogs, and fitted them to the mortises, key snugly, taking care to make as good a fit between each key and pair of cogs as was made between the cogs and mortises; put in a pin shown at *h*, Fig. 4, putting a pin in each key, not to help hold it in place, as far as sustaining the cogs is concerned, but to prevent the key from flying out should it get loose by any means.

The key is a very important part of a cogged gear, and each key should be thoroughly fitted to bear "all around." The spaces *a* and *b*, between the dotted lines, should bear fair and square against the bottom of the gear, and the portion *c* should also be made to bear. The strips *d* and *e*, on each side of the part *c*, should *not* bear upon either gear or cog, and these are about all of the keys, except bottom and ends, which have nothing to do. The sides of the key, between *f* and *g*, should be particularly well fitted. These parts do the most of the work of holding the cogs in place.

In driving keys, take great care that one key is not driven tighter than another. If one is tighter than its neighbor, the cogs on either side are twisted or bent out of place as far as the spring of the wood will permit, and if the millwright persists in driving one key, he will shear off one or both of the adjacent cogs.

Having driven all the cogs and keys, tightened the latter evenly, and gotten

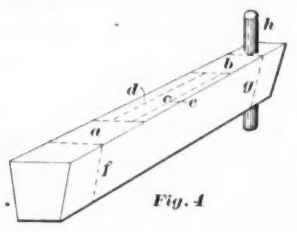


Fig. 4

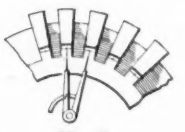


Fig. 6

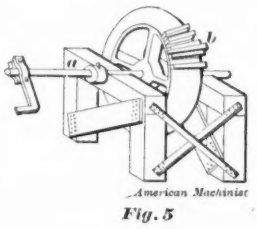


Fig. 5

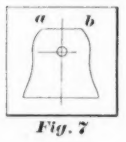


Fig. 7

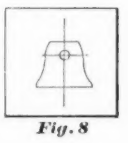


Fig. 8

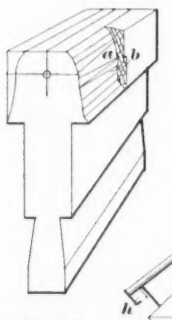


Fig. 10

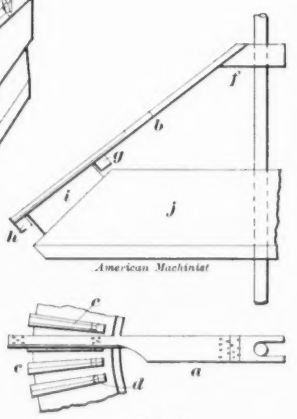





Fig. 9

COGGING A MORTISE GEAR.

everything satisfactory in regard to the cogs and keys, it is time to true up the gear and cut the teeth. The first step is to "fill" the gear. This is done by driving pieces of *soft* wood, either pine, bass, poplar, hemlock, or some similar kind, between the square cogs, as shown at *b*, Fig. 5. The projecting ends of the filling pieces are cut off with a saw, close to the gear teeth. The gear, if not fast on the shaft where it is to run, is temporarily mounted on a short bit of shafting, as shown in the engraving.

A clamp dog is put on the end of the shaft, provided no power is to be had, and one or two of the "cubs" (boys) set to revolving the gear. If there is power in the mill, slip a pulley on the shaft, and a belt will work better than half a dozen boys. The collar *a* will take the thrust of the turning tools, and keep the gear where it belongs.

After the gear has been turned on the face, or ends of the cogs, and on the edges, the pitch lines, on both front and back edges of the teeth, should be marked, by cutting into the teeth while the gear is revolving, a sharp pointed tool being used to make the mark. The proper location of the pitch line should have been determined before the old gear was destroyed, or it may be taken from one of the old cogs, or ascertained from the maker of the gears. Pitch lines are usually located about one third length of tooth from outer end.

Fig 6 shows a section of the gear with pitch line marked. The opposite ends of the teeth are marked in a similar manner, then, with a pair of very *sharp*, stiff dividers, space around the gear *on the pitch line*, starting at the center of a cog, and keeping as near the centers as accuracy of the mortises will permit; the short cross lines show the centers as thus located.

A couple of templates should be cut from brass or sheet zinc. The far seeing millwright will have made such templates from every mortise gear in the mill, then he will have them on hand when needed. Figs. 7 and 8 illustrate templates for front and back end of tooth respectively. Drill the center holes indicated by the small circles, put an awl through the center hole, and into center hole or end of cog, then, with the template thus located, mark around it with a pencil. The top of the teeth should have been turned true, so as to serve as a guide in keeping the template square, the top of template being kept fair with the top of tooth during the making.

It is now necessary to square down across the top of the tooth in order to locate the center point on back edge of cog. This may be done by simply looping the end of a fine string, and holding the loop around the shaft at such a distance from the hub that the string will lie parallel with and just touching the face of the cog. With this line held on the front cog center line, the back center of the cog may be quickly located, and then squared down across the pitch line.

Better than the line is the device illustrated by Fig. 9, shown in plan at *a*, and in elevation at *b*. It consists of a strip of well seasoned pine or mahogany nailed or screwed and glued to a block *f*, which has been worked out to fit the gear shaft. The lower end of the strip is cut down and chamfered to line with center of shaft, as shown at *a*, and the blocks *g* and *h* are also chamfered and glued on to the center line. When block *h* is placed fair with center line or outer edge of tooth, the center line can be struck along *a*, and directly down the inner edge of tooth by means of block *g*, as shown at *c* and *d*. The points *a* and *b*, Fig. 7, can also be struck across the tooth, as shown at *e*, Fig. 9. These marks are very necessary when dressing the tooth to shape, as may be seen in Fig. 10, which shows the first steps to be taken.

A good, sharp paring chisel (perlner) is the best thing to size cogs down with. Begin at one edge of the tooth, as shown in Fig. 10, and cut about half across, taking only what chips can be carried by pushing the chisel by hand. The size and thickness of chip taken is the guide to go by in cutting, and the width of cut left on cog tells whether the chisel has gone too deep, or not deep enough, at *a*, Fig. 10, the chisel has run a little too deep. At *b* it has not gone deep enough, and a bunch or ridge is left. When the scores are all of the same width, as at *c*, then it is pretty sure that the cog has been cut evenly all the way across.

Next, after shaping one edge of part, on all the cogs, serve the other edge in the same manner, then dress off all the corners with chisel and a small iron plane, after which file up with a big wood file, and sand paper if desired, but I like best to omit the sand paper as it beds into the cogs, and wears for some time before falling out on becoming pulverized.

After finishing the cogs to suit give them a coating of hot oil. Tallow and plumbago is a good mixture for large cogs. Small ones may be dosed with any heavy oil (cylinder) mixed with a little very fine plumbago. If ready finished cogs are used; they may be stood on end in a shallow pan and boiling oil poured around them, and allowed to penetrate the wood as much as possible.

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NEW YORK, AUGUST 23, 1894.

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## A Screw Machine Test.

We hear a good deal of competitive tests of various kinds of machinery, especially of engines, reapers, etc., but not so much of such tests of machine tools, the difficulties of making them entirely fair being, probably, considerably greater in the case of machine tools than in most other classes of machinery. A test of turret screw machines took place not long ago, however, which brought out some interesting results, particularly as showing the remarkable efficiency attained by these machines.

We regret that the test took place under circumstances which make it impossible for us to give names of the builders of the machines, but it is sufficient to say that one of them is especially designed for such work as was done during the test, which involved considerable changing and "setting up" of tools, there being nine distinct kinds of bolts made, varying in diameter from $\frac{1}{2}$ inches to $1\frac{1}{16}$ inches, and in length from $2\frac{1}{2}$ inches to $8\frac{1}{8}$ inches, some having "hex" heads, and some round heads. The shanks of 54 of these bolts were fitted, the others being turned to gauge. In all there were 202 bolts made by each machine during the test, and the time of one machine was 13 hours 30 minutes; of the other machine, 22 hours. To have made the same lot of bolts in the lathe, chasing the threads in the usual way, would have required at least 100 hours time, we think, under the best conditions, and ordinarily, considerably more, so that a comparison of the lathe, even with the least efficient of the screw machines, is very favorable to the latter.

The manner in which this test was brought about, and its results, are interesting in another way.

The successful machine in the contest had been in use in the shop two or three years. When the new machine was put in, an expert was sent to operate it and give instructions. This expert, while he did not, so far as we know, mean to be unfair, was, of course, a partizan, and was working in the interest of his employers. He succeeded in convincing about everybody in the establishment that the older machine was intrinsically inferior to his own, and could not produce work as well nor as rapidly. Hearing of this, the builders of the older machine sent *their* expert. He put the machine in good working order, and the two experts then each took an equal lot of bolts, of varying proportions, as described, and each finished them as quickly as he could, the result being that it was shown that for that particular work, the older machine could produce about 30 per cent. more work than the new one. This is different from demonstrating which machine is absolutely the best one for all the purposes to which such machines can be put, and proved nothing but that for this particular work, which fairly represented the work required of them in that shop, the older machine was best of the two.

Another thing which it showed—and perhaps this is more important than any other feature of the case—is that when the relative merits of different machines are to be determined, some pains must be taken to secure for both machines the best possible, or at least equal, conditions, and that it is not proper to compare the work of two machines, when one of them is handled by an interested and highly-trained expert, while the other is handled by an uninterested and not specially trained operator. In other words, scientific methods should be followed when testing tools, as well as when testing engines or other machinery.

The plans set forth for making of a fire engine something besides a machine operated by steam and propelled by horses has been interesting, but after all the consideration of compressed air and power from electric lines, the correspondent in this issue who signs himself "Troy" makes a statement of the case that is not easily got around. "Troy," as we happen to know, has gained his experience right in the service, and what he has to say is worth consideration from those who see the removal of the steam and horses from a fire engine as a simple matter. The question of cost in operation in the instance of a steam fire engine is insignificant compared with the ability to get quickly to the scene of action and get water on the fire. Some of the problems though briefly are nevertheless well stated by "Troy."

## Steering Ships by the Sun.

It is reported that Lieutenant Beehler, of the Navy, has invented a substitute for the compass for use on shipboard. It is called a solarometer, from which we conclude that it depends upon an observation of the sun (at least in day time) for determining the meridian, and it includes in its mechanism a telescope through which observations are made, and a vessel of mercury hung in gimbal joints for maintaining a level base for the instrument.

It is, of course, well understood that all measurements to determine the meridian by solar observation must be angular measurements. The latitude of the place of observation, and the declination of the sun, *i. e.*, its angular distance from the celestial equator must not only be accurately known, but must be set off on the instrument with considerable precision—a precision which, however, is entirely useless, unless a level line, or artificial horizon, can be secured and maintained for a sufficient length of time to complete the observation. This level line forms the real basis from which all the angles are measured, and any one with experience in handling such instruments, knows that a very slight error in level manifests itself very plainly in the result. If Lieutenant Beehler has perfected a device by which he can maintain the level base on board a moving ship at sea, then he has undoubtedly solved the problem of accurately determining the points of the compass, regardless of the disturbing influence of magnetic variation, or of the influence which steel ships exert upon the magnetic needle; but it seems almost incredible that a sufficiently accurate and stable level base can be obtained by this means.

An instrument capable of determining the meridian by solar observation could also determine it by observation of any other heavenly body, the declination and right ascension of which was known, and this would make its use practicable at night, if provided with a telescope having cross hairs; but neither by day or night could it be used at all, unless the weather were clear, and when the weather is not clear is just when it is most important to know the exact direction in which a ship is moving. It would thus appear that if the new invention does really overcome all the difficulties attending the use of the magnetic needle in steering ships, it has accomplished no mean thing, and its inventor is entitled to a very great deal of credit.

Americans are very commonly credited by their English cousins with doing a good deal of bragging anent their performances, and they are generally willing to admit that they brag quite enough. But bragging, as we have before said, is a rather world-wide weakness. However, we can all remember how unmercifully—only a short time since—we on this side of the water were ridiculed by our British critics when we ventured a word—never so modestly—about fast railroad trains. They would submit to no comparisons because we had nothing to compare in the way of speed. Now, as a matter of facts, a train has been making a long run on the New York Central every day for two years, easily beating anything of the kind in England, and we venture to say that 49 out of 50 people in this country who ever heard of it have forgotten it. We confess to not being likely ever to have thought of the matter again except from having recently seen the fact grudgingly, and only half admitted by an English journal. We refer to the Empire State Express that runs from New York to Buffalo—440 miles—in eight hours and forty minutes, and there is nothing remarkable about it at that.

## Railroad Passes.

Some good might come of the matter of prohibiting free railroad passes, which has been under more or less discussion by the Constitutional Convention at Albany for several weeks, if it were made part of the constitution of the State; not very much of good, we should think, but if only a little it would be well to that extent. The proposed amendment is to the effect that no official of the State shall receive a free pass for himself or others, or any free or discriminating rates for transportation of goods or merchandise from any railroad company. If this becomes part of the constitution of the State it will relieve railroad companies from some of the burden of granting passes to every cross corner official and his friends lest he should oppose them in digging a ditch somewhere, and probably make the feeling that the railroad company owned every little official in the State less pronounced. In a word, it would soften to some extent the strong prejudice against railroads, which, as everybody knows, is as likely in almost any instance to be wrong as right; that is, it is blind. Of course, when it comes to matters of especial importance the railroad companies will go right on, as usual, buying the legislature at the ruling price, so there will be no shock to business in that respect. Such a law, as experience has shown, is easily enough evaded, but its evasion will not be sweeping because of the desire of the railroad companies to take some advantage of it, and the impracticability of unlawfully dealing with the multitude. There is at least a probability of such an amendment to the constitution of the State being of some little value in petty matters, such as tearing up streets without hindrance from city officials, and the like. This is all we should think the people would be likely to gain from it, and, of course, not always this.

Commercial travelers, as is well known, are successful in a great degree in comparison as they possess the faculty of making themselves agreeable. This and a careful study of the wants of the trade is their stock. As an example of a combination of both these traits we remember, when dealing considerably in pipe and fittings, a drummer, whom to get rid of was an artistic operation. In fact, looking back through some years, we do not remember to have been the one he left without some kind of an order. It wasn't because he was offensively persistent—you can get along easily enough with that kind of a fellow—but he had a way beyond description of convincing you that you lacked something in his line. When he came in you knew you didn't want anything. When he went away you were satisfied that if he had not called you would have missed something that would have interfered with your business.

W. H. Dayton, of the Excelsior Needle Co., Torrington, Conn., sailed for Europe on the "Paris," on the 15th, to be gone about two months for business and recreation.

Professor John E. Sweet and wife will sail for the same destination on the 8th of September.

## Literary Notes.

We are indebted to Mr. Arthur Falkenau, of Philadelphia, for a pamphlet which is a reprint from the Proceedings of the Engineers' Club, giving a paper by Mr. Falkenau on "The First United States Pneumatic Postal System." The paper goes into the subject quite thoroughly, and gives an account of the leading features of European systems, as well as the plant in Philadelphia with which the author has been connected as an engineer. The paper is fully illustrated, and is very interesting. Mr. Falk-

enau states that pneumatic transmission by tubes is not mechanically economical; only 10 per cent. of the power required being applied to the work of moving the carrier, while 90 per cent. is wasted in accelerating the air and in its friction. Commercially, however, it proves very economical.

POOR'S MANUAL OF RAILROADS.

The 27th annual number for the year 1894, has been issued. It contains a vast amount of information relating to the railroads of the United States, Canada and Mexico, their histories, financial standing, equipment, etc. No one who has occasion to keep well posted on railroads can afford to be without this manual, which has long since become standard. Published by H. V. & H. W. Poor, New York.

## QUESTIONS AND ANSWERS.

*Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.*

(393) E. T. S., Toronto, Can., asks: Can flat steel $\frac{1}{32}$ inch and $\frac{3}{4}$ inch wide be welded by electricity so as not to injure the steel? *A*—Yes. 2. Will it be possible to temper this steel and not show a weak spot? *A*—We believe it can. 3. Who does such work? *A*.—Electric Forging Co., Boston, Mass.

(394) H. K., Buffalo, N. Y., asks:—What appliances are there for preventing smoke from soft coal, how successful are they and what do they cost? *A*.—It would be impossible to enumerate the devices for this purpose, costing all the way from $10 to $1,000. So far, a good fireman is perhaps the most successful. 2. Will steam jets for this purpose injure the boiler? *A*.—No; not if properly used.

(395) G. C., Pueblo, Colo., writes: In one of your issues you have illustrations of a Corliss valve gear. I have sent my copy to a friend, so I cannot give you the date. Kindly send me two copies of this issue. *A*.—The illustrations to which you refer will be found in our issue of July 3, 1890. We have no numbers published previous to 1893 in stock, and, therefore, cannot comply with your wishes.

(396) J. B., Allegheny, Pa., asks: Can you imform me where I can get working drawings of a Corliss engine? *A*.—We know no other way of procuring these drawings than by buying them of a builder of Corliss engines, or by buying the book treating on these engines, by W. H Uhland. The latter is a very expensive book, but it is probably as cheap as a set of drawings bought from a builder.

(397) A. K., Montreal, Canada, writes: Kindly inform me from what source I can get a full descriptive explanation of the construction and working of the Corliss engine. *A*—You will find the information you seek in W. H. Uhland's book treating on the Corliss engine and allied steam motors, working with or without automatic variable expansion gear, including the most approved designs of all countries, with special reference to the steam engine of the Paris International Exhibition of 1878. Translated, with additions, by A. Tolhausen.

(398) W. C., Philadelphia, Pa., writes: Kindly give me the addresses of builders of machinery for the manufacture of matches, also for splitting whalebone. *A*.—The demand for machinery of this kind is so small that it is very doubtful if there is a manufacturer who makes a specialty of building machines of this class. Probably builders of woodworking machinery, the addresses of some of these are given in our advertising columns, may build them for you. It seems to us that you will have to get drawings made by a competent mechanical engineer, and then have the machines built to order.

(399) W. L. C., Grand Rapids, Mich., writes: There is in your city some one who sells a little book containing designs of and directions for constructing letters and figures with parts of a Chinese toy known as the "Fangram." The toy consists of seven pieces, and when put together form a square. Any information you may give me in regard to this will be greatly appreciated. *A*.—The toy is called the "anchor puzzle; it is made in Germany, and can be obtained from E. I. Horseman, dealer in toys, 341 Broadway, New York. A book of directions and patterns accompanies the toy. Price, 20 cents.

(400) J. B. H., Meriden, Conn., writes: Kindly inform me what I can put on the outside of cotton hose to keep it from decaying. *A*.—A manufacturer of cotton hose informs us that the treatment of the hose during its manufacture is such as to prevent decay, and nothing can be used afterwards without injuring the rubber. 2. What size of hole in the nozzle will throw the water through the greatest distance? The hose is $\frac{3}{4}$ inch diameter, pressure about 50 pounds per square inch. *A*.—In practice the general proportions of the nozzle are: Length from 6 to 10 times the diameter of the hose, and the outlet end of the nozzle is $\frac{1}{4}$ of the diameter of the hose. According to this you will need a $\frac{1}{4}$-inch hole in the nozzle.

(401) W. H. L., Oil City, Pa., writes: I would like to inquire as to the best drawing table on the market according to your knowledge of them, and in what issues of the AMERICAN MACHINIST were they illustrated. *A*.—You will find illustrations of drawing tables in our issues of September 15, 1888; January 9, 1890; January 28, 1892; November 9, and December 21, 1893; February 15, and April 5, 1894. From these you must make your own selection; we cannot recommend one in preference to others. 2 I would like to know of some good book treating on co-operation and profit sharing. *A*.—Probably the "Manual for Building and Loan Associations," by H. S Rosenthal, will furnish you the information you seek.

(402) N. O. P., Maori, New Zealand, writes: Please furnish me with the addresses of firms who manufacture an electric apparatus for domestic use, such as cooking, heating flat irons, etc. I have read descriptions of such apparatus exhibited at the Chicago Exposition, but have been unable to procure particulars. Kindly state your opinion of such apparatus, and whether you think it can be applied to do the cooking in large public institutions. Perhaps some of your readers will kindly give their experiences. *A*.—The manufacturers of domestic heating apparatus, etc., are: American Electric Heating Co., Boston, Mass; Ansonia Electric Co., Chicago, Ill.; Burton Electric Co., Richmond, Va; G. Cutter, Chicago, Ill.; and Railway Equipment, Chicago, Ill. We cannot express an opinion, as we have had no experience in this line. We shall be pleased to hear from our readers.

(403) A. A. A., Chicago, Ill., writes: Please describe the process for tempering common helical car springs. The size of steel is $1\frac{1}{4}$ inches to $1\frac{3}{4}$ inches in diameter, outside diameter of springs from 4 to 6 inches, height 8 to 10 inches. *A*.—For springs made of steel of such a large cross-section, the following process has been adopted: Heat the spring evenly to a cherry red, and immerse it in a tank containing fish oil, and swing it slowly back and forth, then cool in a tank of water. The period of immersion depends on the cross section of the steel, and is governed solely by the operator's judgment; the time of immersion in oil will be about 35 to 40 seconds for the springs referred to; if on removal the oil on the spring takes fire, it should be re dipped for a second, and then put in the cold water tank to cool off. To keep the tempering oil cool at an even temperature, the tank of fish oil is placed in a second or outer tank containing water, a circulation in the latter is maintained by a pump, the water being kept cool by a constant overflow. Resin and pitch are sometimes added to the oil to increase its hardening capacity. When only a few springs are to be tempered, the spring is heated evenly to a cherry red and immersed in fish oil, until, according to the operator's judgment, it is sufficiently cooled and then held over a blacksmith's fire and the oil blazed off, when a blue flame appears, the spring is removed and allowed to cool in the open air. If after this operation it is found that the spring is too hard, it is re dipped in the oil and again blazed off.

(404) Machinist, Richmond, Va., writes: I inclose a sketch of a skeleton frame made of steel and wood, the following are the dimensions of the materials used: Side rails $\frac{5}{8}$ inch thick, $1\frac{1}{2}$ inches deep; slats $\frac{3}{16}$ inch thick, $1\frac{1}{2}$ inches deep; cross bars $\frac{5}{8}$ inch thick, $1\frac{1}{2}$ inches deep. These form 66 cells $1\frac{1}{2}$ by 4 inches. I shall consider it a great favor if you will give me some information as to the best material to use for these frames, and refer me to a manufacturer who could make them reasonably cheap in large quantities. I will state I am now making these frames out of steel and hard wood; steel is too heavy and unnecessarily strong; hard wood is strong enough, but it causes too much friction, and besides it is liable to warp, which is somewhat objectionable. I would like to make them out of some material that is not as strong as metal, and is nearly as light as wood. I would also like the material to be such as can be washed, as in the use of these frames they become dirty and will have to be washed once or twice a month. *A*.—It seems to us that aluminum will be the most suitable material for your purpose. It answers all the requirements—it is light, strong enough, it will not warp, can be very easily kept clean, and will not cause much friction. The expense, at first sight, may appear to be objectionable, but when it is remembered that with the use of aluminum the whole frame can be cast in one piece, thereby saving the expense of labor of building the frame and that the dimensions of the details can be reduced, it is doubtful if the expense will be a serious objection. There are several firms in your city who should be able to make these frames for you.

(405) J. F. S., Atlanta, Ga., writes: Please inform me how to get the pitch diameter of a pinion or gear if either of them is lost. *A*.—First find the diameter of the pitch circle of the gear on hand. This is found by subtracting from outside diameter of the gear, or the addendum circle, the whole depth of the tooth, and adding to the remainder $\frac{1}{10}$ of the thickness of the tooth measured on the center of its depth, all in inches, the result will be the pitch diameter. Multiply this diameter by the number of teeth in the lost gear, and divide the product by the number of teeth of gear on hand, the quotient will be the pitch diameter of the lost gear. 2 Please inform me how it is determined that the pitch is 7 or some other figure. *A*.—We presume that you refer to the diametral pitch. If the circumference of the pitch circle is divided by the number of teeth in the gear, the quotient will be the circular pitch. In the same manner, if the diameter of the pitch circle is divided by the number of teeth, the quotient will be the diametral pitch. Thus, if a gear is 12 inches pitch diameter, and has 84 teeth, and if we now divide 12 by 84, we have $\frac{12}{84} = \frac{1}{7}$ inch for the diametral pitch of this gear. Generally, in speaking of diametral pitch, the denomination of the fraction only is named. $\frac{1}{7}$ inch diametral pitch is then called 7 diametral pitch. That is, it has been found more convenient to take the reciprocal of a diametral pitch in making calculations. The reciprocal of a given number is the quotient obtained by dividing 1 by the given number. Thus the reciprocal of $\frac{1}{7}$ is 7, because $\frac{1}{7}$ goes into 1 seven times. From the foregoing we have the following definition: Diametral pitch is the number of teeth to one inch of diameter of pitch circle. Thus $\frac{1}{7}$ inch diametral pitch we would call 7 diametral pitch, because there are 7 teeth to every inch in the diameter of the pitch circle. 3. Which is a good book on this subject? *A*.—"Practical Treatise on Gearing," published by Brown & Sharpe Manufacturing Co., Providence, R. I.

(406) L. B. M., Vicksburg, Miss., writes: In answer to question 300 you said that for shrinking locomotive tires on their centers .00106 inch per inch in diameter is allowed. Are you sure that by working to those figures you will make a fit that will stand the ordinary wear? In figuring on .00106 inch for a 5-foot center I get .0636 inch, which I am sure is less than what is allowed for shrinkage of tires on 5-foot centers in the repair shop in which I am engaged. *A*.—In 1886 the American Railway Master Mechanics' Association recommended and adopted the following diameters as standards:

| Diameters of Wheel Centers. | Inside Diameters of Tires. |
|---|---|
| 38 inches | 38 inches less 0.040 inch. |
| 44 " | 44 " " 0.047 " |
| 50 " | 50 " " 0.053 " |
| 56 " | 56 " " 0.060 " |
| 62 " | 62 " " 0.066 " |
| 66 " | 66 " " 0.070 " |

From the above table we find the average allowance for shrinkage to be .00106 inch per inch. Practice has shown that this allowance is sufficient. 2. In taking off an old tire by heating it by means of peforated pipes placed around the tire, encased by sheet-iron covers, does the heat affect the centers enough to produce an error in making a fit with a new tire, I mean taking the size of center immediately after the old tire has been taken off? *A*.—The heat may affect the center, we should never measure it before it has been thoroughly cooled. 3. What is the pressure per square inch, and at what distance can water be thrown through a 1 inch nozzle standing 500 feet from a reservoir, which is 180 feet high, and sets on a hill 300 feet above the level of the nozzle? *A*.—That will depend on the diameter of the water main, the smoothness of the inner surface and the number of bends in it. You will find rules for computing the height to which the water can be thrown in the treatise on "Hydraulics," by M. Merriman, published by John Wiley & Sons, 53 East Tenth street, New York.


## BUSINESS SPECIALS

*Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.*

Cleveland, Cleveland, Cleveland, Grant, p. 12.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Pattern and Brand Letters. A variety of sizes and styles. Hèber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

American packing rings are in touch with the cylinder. J. H. Dunbar, Youngstown, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

Model Locomotives. Complete sets castings N. Y. Central Standard up to date. Rough or finished. G. H. Olney, 163 Herkimer St., B'klyn., N. Y.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—Emery, emery wheels, grinding machines, knife powders and sharpeners, paste and liquid polish, whetstones, etc., etc.; quick process and large stock. Customers annoyed by the delays due to long processes and small stock can get goods in a hurry by buying of The Tanite Co., N.Y. City, Cincinnati, O., and Stroudsburg, Pa.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street New York.

"Modern Locomotive Construction." By J. G. A. Mey r. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.


## Results of Experiments with a Fifty Horse-power Single Non condensing Ball and Wood Engine to Determine the Influence of Compression on the Water Consumption.*

BY PROF. D. S. JACOBUS.

In a paper presented to this society, at the recent Chicago meeting, by Mr. F. H. Ball,† a theory was advanced in regard to the probable effect of compression on the economy of the steam engine, and a law was suggested for determining the most economical compression curve. Since that meeting, an opportunity has been afforded, at the Stevens Institute of Technology, for investigating this subject by experiment, and the following pages are a record of the facts thus obtained.

The engine used for this purpose, which will be more fully described further on, was provided with two valves for alternate use, one of them being a special valve arranged for obtaining full compression to initial pressure, as shown in Fig. 1 (page 10). Owing to the rather large clearance of this engine, it was found impracticable to obtain the compression curve sought, if any later cut off was used than the one shown, giving only about 20 pounds M. E. P., and thus limiting the M. E P. of Fig. 3 to about 30 pounds, which is considerably below the rated capacity of the engine at which it is supposed to give its highest economy. It was also found necessary to reduce the pressure to about 71 pounds to obtain the desired compression, and the temporary foundation made it necessary to run the engine about 50 revolutions per minute below its normal speed; so that, because of this reduced speed, the low boiler pressure, and the small load, the con-

* Presented at the Montreal Meeting of the American Society of Mechanical Engineers.

† *Transactions American Society of Mechanical Engineers*, Volume XIV., p. 1067. AMERICAN MACHINIST, August 24, 1893.

sumption of steam per indicated horse-power per hour was considerably above what might have been expected from an engine of this class under more favorable conditions. These unfavorable conditions, however, did not present any obstacles to the investigation that was sought regarding the relative economy of varying amounts of compression.

The experiments prove that for either equal amounts of work produced, or for equal points of cut-off, the cushion steam in an engine should not be compressed as high as the initial pressure but to some lower pressure in order to obtain the best economy, thus verifying conclusions arrived at by theory in the paper referred to.

The results obtained are as follows:

With a special valve in the engine, so arranged as to compress the cushion steam to the initial pressure, and cut-off at one-quarter stroke, the steam consumption was 37.9 pounds per hour per horse-power.

For the same work as with the special valve, and compression to two-thirds the initial pressure, the steam consumption was 36.8 pounds per hour horse-power.

For the same cut-off as the special valve, and compression to about five eighths the initial pressure, the steam consumption was 34.8 pounds per hour per horse power.

The cylinder dimensions were: bore, 10 inches; stroke, 11 inches. The steam pressure averaged about 72 pounds above the atmosphere, and the revolutions 250 per minute.

The average indicator cards for the three sets of conditions are given in Figs. 1, 2 and 3.

The special valve released the steam at a later point in the stroke than the regular valve, so that small corrections have been made in the above figures to eliminate variations from this cause, by extending the expansion line in each case to the end of the card, as represented in Figs. 1, 2 and 3.

A Barrus calorimeter was employed to determine the amount of moisture present in the steam, and the moisture was deducted to obtain the steam used. In making the tests, the work developed by the engine was absorbed by means of a Prony brake. The exhaust steam was condensed in a surface condenser, and weighed. Indicator cards were taken every five minutes, the indicator being cleaned and oiled between each three cards. Readings of the revolutions, temperatures, pressure, etc., were also made every five minutes. The water was collected in barrels, and weighed each fifteen or twenty minutes. The weighings agreed very well among themselves. All tests were an hour or longer in duration. In order to make certain that the tests were long enough to insure the proper accuracy, the steam per hour per horse-power was calculated for the first half of five of the runs, and the maximum discrepancy between the results for the first half of the runs and the entire runs was found to be one-tenth of a pound of steam per hour per horse-power, or about one-fourth of one per cent., this is less than the possible error, and thus proves that the tests were of ample length.

The results of the separate tests are given in Tables I. and II. The tests made under similar conditions are seen to agree very well among themselves, the greatest discrepancy being one per cent.

[The results of the tests were given in detail by the author in tabular form, Tables I. and II., which we reproduce, being made up from these.]

The Barrus calorimeter was attached in the main steam pipe about three feet from the steam chest. The waste steam was carried off a short distance through a three-quarter-inch pipe, which produced a slight back-pressure, so that the lower thermometer read 213° when the exit steam was saturated. The various percents of priming are given along with the average data for the tests in Table III. . . . .

The indicator spring was tested over the entire range of the indicator cards, and all variations in the scale were corrected for by employing the scale corresponding to each ordinate of the forward and back-pressure lines, as explained at the last meeting of this society in a paper on the Comparison of Indicators. Cards for each set of conditions were taken, and it was found that the differences in the equivalent scales corrected for all variation between the cards under the several sets of conditions, and between the largest and smallest cards of a set, were within the limits of practical errors. The average of the scales, or 58.2 pounds per inch, was, therefore, used in computing the horse-power.

A small variation in the amount of work done will cause a greater discrepancy in the results than the difference between the economy at full and for partial compression; so that unless the greatest care be exercised in performing the experiments, the comparative results may be misleading.

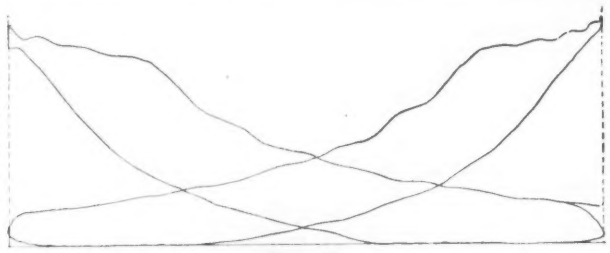

*Fig. 1.*

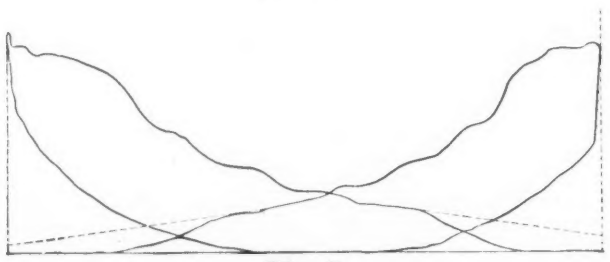

*Fig. 2.*

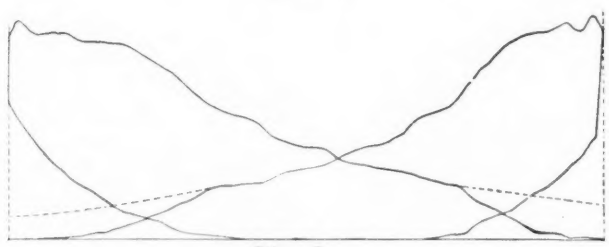

*Fig. 3.*

TABLE I.

FINAL RESULTS OF TESTS, CORRECTED FOR DIFFERENCES IN POINTS OF RELEASE BY EXTENDING THE EXPANSION LINES TO THE ENDS OF INDICATOR CARDS, AS IS INDICATED IN FIGS. 1, 2 AND 3.

Steam pressure at engine = 72 lbs. above atmosphere. Revolutions per minute, about 250.

| Conditions. | No. of Test. | Duration of test in minutes. | Average mean effective pressure in lbs. per sq. inch. | Indicated horse-power. | Steam per hour per horse-power. |
|---|---|---|---|---|---|
| Special valve so arranged as to compress the cushion steam to the initial pressure. | 4 | 60 | 20 81 | 22.76 | 37.8 |
| | 5 | 100 | 20.90 | 22 80 | 38.1 |
| | 6 | 120 | 20.90 | 22.79 | 37.9 |
| Average | | | 20 87 | 22 78 | 37.9 |
| Ordinary valve. Nearly the same mean effective pressure as for the special valve. Cushion steam compressed to about two-thirds the initial pressure. | 2 | 80 | 20 37 | 22 65 | 36.8 |
| | 7 | 60 | 20 20 | 22 00 | 26 8 |
| | 8 | 60 | 20.02 | 21.62 | 36.6 |
| Average | | | 20 20 | 22 09 | 36.8 |
| Ordinary valve. Same point of cut-off as for the special valve. Cushion steam compressed to five-eighths the initial pressure. | 1 | 105 | 28.14 | 30 29 | 35.0 |
| | 3 | 75 | 27.30 | 30.46 | 34.7 |
| Average | | | 27.72 | 30.38 | 34 8 |

TABLE II.

FINAL RESULTS NOT CORRECTED FOR DIFFERENCES IN THE POINTS OF RELEASE SO THAT THE STEAM USED PER HOUR PER HORSE-POWER GIVEN IN THIS TABLE IS THAT ACTUALLY CONSUMED BY THE ENGINE.

| Con itions. | No. of Test. | Duration of test in mins. | Average mean effective pressure in lbs. per square inch. | Indicated horse-power. | Steam per hour per horse-power. |
|---|---|---|---|---|---|
| Special valve so arranged as to compress the cushion steam to the initial pressure. | 4 | 60 | 20.69 | 22.63 | 38.1 |
| | 5 | 100 | 20 78 | 22.68 | 38 3 |
| | 5*a* | 40 | 20 89 | 22.78 | 38.2 |
| | 6 | 120 | 20.78 | 22.71 | 38.1 |
| | 6*a* | 60 | 20.72 | 22 62 | 38.2 |
| Average, not including partial runs, marked *a* | | | 20 75 | 22 67 | 38.2 |
| Ordinary valve. Nearly the same mean effective pressure as for the special valve when allowance is made for differences in the points of release. Cushion steam compressed to about two-thirds the initial pressure. | 2 | 80 | 18.66 | 20.75 | 40 2 |
| | 2*a* | 40 | 18 71 | 20.80 | 40.2 |
| | 7 | 60 | 18.48 | 20.13 | 40.2 |
| | 8 | 60 | 18 31 | 19 77 | 40.0 |
| Average, not including partial runs, marked *a* | | | 18.48 | 20.22 | 40 1 |
| Ordinary valve. Same point of cut-off as for the special valve. Cushion steam compressed to five-eighths the initial pressure. | 1 | 105 | 25.99 | 27.98 | 37.9 |
| | 1*a* | 60 | 25 99 | 28 01 | 37.9 |
| | 3 | 75 | 25 23 | 28 15 | 37 5 |
| | 3*a* | 45 | 25.08 | 27 99 | 37 6 |
| Average, not including partial runs, marked *a* | | | 25.61 | 28.06 | 37.7 |

The averages marked *a* are for the first portions of the corresponding tests. These averages are used in calculating the performances for the first portions of the runs, which are shown not to vary over one-fourth of one per cent from the results deduced for the entire runs. This indicates that the runs were of sufficient length. For comparative figures see Table V.

DISCUSSION.

The secretary read a discussion submitted by Prof. John H. Barr, of Sibley College, in which he gave an account of some experiments made by him, in which different results were obtained, results showing apparently that the conclusion to be drawn from Professor Jacobus' experiments might be contradicted by other experiments.

Mr. Ball said he agreed with Professor Barr in some of the points made, but he suggested that an explanation of the apparent differences between the results obtained by the two sets of experiments might be found in (what he presumed was the fact) that Professor Barr's engine had very small clearance, while the engine tested by Professor Jacobus had unusually large clearance.

Professor Jacobus then drew upon the board, cards representing those obtained by Professor Barr and by himself, and stated that the results obtained by Professor Barr under the conditions shown by his cards really agreed with his own results and were just what should have been obtained under the conditions according to the theory.

## In the Engine Room of the "Lucania."

*The Engineer* of London publishes under the above title some interesting facts and figures pertaining to what are now the largest and most powerful steamships engaged in the transatlantic service. Our contemporary says:

". . . It will be well here to go over somewhat old ground, and supply a few particulars of the construction of the main engines. They are each intended to indicate 15,000 horse power, and that power has actually been obtained. We believe, however, that the average working power is 28,000 horse power for the two. They are peculiar in arrangement. Each engine has five cylinders and three cranks. There are two high pressure cylinders 37 inches in diameter. These stand each over a low-pressure cylinder, 98 inches in diameter, a single piston rod serving for each pair of pistons. Between the two low-pressure cylinders is placed one intermediate cylinder, 79 inches in diameter, into the valve chest of which both the high pressure cylinders exhaust. The stroke of all the pistons is 69 inches. The capacities of the cylinders are to one another roughly as 10 : 49 : 75. But, inasmuch as there are two low pressure and two high-pressure cylinders to one intermediate, the real proportions come out very nearly as 21 : 49 : 150, or as 3.7 and 20.3. If steam were cut off at half-stroke in the high pressure cylinder, and the effect of clearance neglected, the total expansion would be about 13.5 to 1. The safety valves are loaded to 165 pounds, so that if we take the initial steam pressure as 175 pounds absolute, the terminal pressure would be a little under 13 pounds absolute. This is, of course, higher than that obtained in practice, for sufficiently obvious reasons. Various changes have been made in the propellers of the "Lucania" and "Campania," and we do not know what is the precise number of revolutions made per minute now. We shall not be far wide of the mark, however, if we take it at a little more than 71, corresponding to a piston speed of 820 feet per minute. The two high-pressure pistons have piston valves. The propellers are three bladed, of manganese bronze, cast at Fairfield. The total weight of the six blades of the two propellers is 48 tons, which is the weight of about 5,500,000 pennies, the normal value of which would be £22,916. We need scarcely add that pennies were not used for the purpose.

. . . The engines are 47 feet high from the base to the top of the high-pressure cylinders; that is about the height to the top of the roof of an ordinary three-story house. The crank shafts are each

made of three pieces, and each piece weighs 27 tons. The thrust shaft is 16 feet long, and weighs 29 tons; the crank shaft is 26 inches in diameter; the propeller shaft, 24 inches. The total weight of crank and thrust shaft, taken as a whole, is 110 tons; each of the six connecting rods weighs 10 tons.

No particulars have ever been made public concerning the quantity of coal used per day; but it is not difficult to arrive at fairly approximate figures, and these are startling enough. It is said that the "City of Paris" and "City of New York"—now the "Paris" and the "New York"—get on with 850 tons per 24 hours. This may or may not be the case; but it is easy to see that the "Lucania" and "Campania" must burn much more. As we have said, we believe it to be pretty certain that these ships each require 28,000 horse-power to propel them at the enormous speeds which they so rigidly maintain. The auxiliary engines in such a ship use a great deal of steam, which is not included in this 28,000 horse-power. The main engines are no doubt economical, but we cannot think that we shall be far wrong if we take the weight of steam used, all referred to the main engines as 16 pounds per hour per horse, which at 8 pounds of water per pound of coal, represents 2 pounds of coal per horse-power, a very good result under the circumstances. It is possible, of course, that the consumption may be less than this, the evaporation higher; but the one cannot be much less, nor can the other be much smaller.

Taking, then, the coal at 2 pounds per horse per hour, we have 56,000 pounds or 25 tons of coal per hour, or 600 tons a day. That is to say, the consumption per day equals the contents of two 30 wagon coal trains.

Through the engines will pass $8 \times 25 = 200$ tons of steam per hour, or $3\frac{1}{3}$ tons of steam per minute; the feed-water will require to pump it into the boilers about, when allowance is made for pipe friction etc., 100 indicated horse-power. The feed-water, taking 36 cubic feet to weigh a ton, would fill a tank 10 feet wide, 10 feet deep, and 72 feet long.

To condense the 200 tons of steam about 7,500 tons of water is pumped each hour through the condensers; that is to say, about one-half the weight—displacement—of the ship. This water would fill a tank 20 feet wide, 10 feet deep and 1,350 feet long, or it would fill a dock 337 feet long, 40 feet wide, and 20 feet deep. Flowing over a weir this volume of water would represent a not inconsiderable trout stream. It is moved, however, with a very small expenditure of power, because there is virtually no head against the centrifugal pumps.

In the boilers—twelve main and two auxiliary—there are 102 furnaces. In each there is nearly 26 square feet of grate surface, or, in all, 2,625 square feet. That is the area of the floor of a great hall, 52 feet long, and 52 feet wide. Fifty tons of coal are required to charge the furnaces, and that is the quantity burning at one time. To burn 56,000 pounds of coal in an hour on these grates, about 25 pounds of coal must be burned per square foot per hour. This is not more than we should expect, seeing that the tops of the chimneys are 120 feet above the grate level, and that very special facilities have been provided for the supply of air to the fire-rooms, although forced draught is not employed. Allowing 20 pounds of air to burn each pound of coal, we find that 250 tons of air per hour must pass up each of the great chimneys, 19 feet in diameter, and 130 feet apart. This, at the probable temperature at the top of the funnel, would occupy a space of about 11,200,000 cubic feet.

The "Campania" has steamed from Sandy Hook to Daunt's Rock at an average speed of 21.28 knots per hour. But taking 21 knots as her velocity, she passes over 2,130 feet per minute. In the same time her pistons make 800 feet. The speed of the ship is thus $2\frac{3}{8}$ greater than that of the pistons. If we take the length of the passage as 2,812 knots, then each piston passes over a space of 1,057 knots, and as there are six pistons, the total distance they make is 6,342 knots. Those of our younger readers who are fond of graphics may find it interesting to plot the path in space of one of the pistons from the data we have given. It will be seen that the relation between the speed of a piston and that of a ship is very important. It is evident, for example, that if half the whole power, or 14,000 horse-power, were referred to the low-pressure cylinders of each engine, the average total pressure on the piston could not be less than $2\frac{3}{8}$ times half the resistance of the ship. But as in all probability the thrust effort, multiplied by the velocity in feet per minute, does not exceed one half the whole horse-power, then the piston effort must be twice half the whole resistance. We say half the whole resistance, because there are twin screws. The total thrust on the two blocks will in all probability not much exceed 100 tons, or, say, 50 tons on each.

It will be seen that we have taken the consumption at 600 tons per day of twenty-four hours, and it may be said that this is an exaggeration, and that the consumption is really much less. This may be the case; but if so then either of four things must take place:—(1) The engines do not use 16 pounds of steam per horse per hour; (2) they do not indicate 28,000 horse-power; (3) the boilers evaporate more than 8 pounds of water per pound of coal; or, (4) any two, or all three, of these suppositions are facts. Now, as regards the first point. It will be admitted that a consumption of but 16 pounds of steam per horse per hour represents a very good engine indeed. We are quite aware that higher duties by four, or possibly five pounds have been attained, but not at sea, and only under almost exceptional circumstances on land. In this 16 pounds we have included, be it remembered, all the steam used in driving, pumping, and electric lighting engines; for heating, and all the thousand and one uses to which steam is put in a great ship, and all used, be it observed, more or less uneconomically. As regards the second point, we have every reason to believe that the power exerted is more nearly 30,000 horse-power than 28,000 horse power. There remains only the boilers to be considered. There is nothing about them specially economical; nor is Welsh coal used, nor is the feed-water supplied at a high temperature. We hold, therefore, that an evaporation of 8 pounds per pound of coal would be a very fair duty. But it will be seen that even if the boilers evaporated 9 pounds instead of 8 pounds, it would only affect our calculations by one eighth. The Cunard Company, following the example of the White Star, and indeed, of all other Atlantic companies, refuse to make their coal consumption known. We have, of course, no desire to break through this wall of reserve.

But, on the other hand, it is open to all engineers to speculate, as we have done, on what the probable consumption of the ship must be, and we hold that if the entire horse-power in the ship, auxiliaries and all, is obtained at the rate of 2 pounds of North-country or American coal per horse-power per hour all round, the result is very satisfactory. Every passage across the Atlantic is, in a measure, a race against time, and little account of economy is taken as compared with speed.

It is now time to say something concerning the performance of these phenomenal ships, which have been steadily augmenting their speed almost from the first. Last November the "Lucania" held the record for the fastest westward passage across the Atlantic, the run being made in 5 days 12 hours 47 minutes, the average speed being 20.93 knots. The "Campania," on the other hand, held the record for the quickest eastward passage, the run being made in 5 days 12 hours 7 minutes, or at an average speed of 21.28 knots. The figures are as follows:

"Lucania's" Westward Passage.

| | Knots. |
|---|---|
| Daunt's Rock, 12.55 P. M., October 29th, to noon October 30th | 481 |
| October 31st | 542 |
| November 1st | 536 |
| November 2d | 490 |
| November 3d | 535 |
| To 9.7 P. M., November 3d, Sandy Hook Lightship | 196 |
| Total | 2780 |

Campania's Eastward Passage.

| | Knots. |
|---|---|
| Sandy Hook Lightship, 9.10 A. M., October 28th, to noon | 47 |
| October 29th | 491 |
| October 30th | 490 |
| October 31st | 491 |
| November 1st | 505 |
| November 2d | 495 |
| To 1.52 A. M., November 3d, Daunt's Rock | 293 |
| Total | 2,812 |

These figures may be compared with those of the performance of the rival ships "Paris" and "New York." They represent average, and not exceptional passages, for all four ships:

Average Passage.

| | Queenstown to New York. | New York to Queenstown. | Knots per h'r |
|---|---|---|---|
| Campania | 5 d. 20 h. 18 m. | | 20.06 |
| | | 5 d. 17 h. 27 m. | 20.76 |
| Lucania | 5 d. 14 h. 27 m. | | 20.64 |
| | | 5 d. 20 h. 50 m. | 19.90 |
| | Southampton to New York. | New York to Southampton. | |
| Paris | 6 d. 15 h. 14 m. | | 19.30 |
| | | 6 d. 22 h. 23 m. | 18.65 |
| New York | 6 d. 20 h. 50 m. | | 18.66 |
| | | 6 d. 20 h. 30 m. | 18.89 |

There is, however, a later performance than any of those we have given. The following extract from the *Liverpool Mercury* of May 28, 1894, gives the particulars of a very remarkable round trip made by the "Lucania": "The westward passage across the Atlantic is usually the most trying and protracted, but on rare occasions a vessel will carry easterly winds with her throughout it. The record passage in that direction was 5 days 12 hours 47 minutes, on the northerly route for a total distance of 2,780 knots. The passage has now been made in only ten minutes longer time on the southerly route of 2,873 knots, or a greater distance by 93 knots. It has been done, too, in spite of the fact of six hours' fog being encountered, during which the vessel proceeded at reduced speed. On the 19.h instant the American line steamer "New York" took her departure from the Needles at 1.35 P. M. The Cunard steamer "Lucania" took hers about 23 hours later from Daunt's Rock, Queenstown, and arrived at Sandy Hook Lightship about 4 hours sooner, having averaged over two knots an hour greater speed than her American competitor. The "Lucania" now excels all records in ocean steaming, in having made the round trip from New York and back again at an average speed of $21\frac{3}{4}$ knots per hour over a distance of 5,784 knots. The fastest railway express in the world could not thus maintain an average speed of 25 miles an hour over a distance of 6,660 miles, with only one break on the journey. Had the "Lucania" sailed on the short route, on which her record voyage was made, her passage would have been 5 days 8 hours 39 minutes. Her sister ship, the "Campania," has already averaged close on to this speed on one trip, but on her present homeward voyage met with easterly gales and high confused seas throughout the passage, besides some fog, through which she was delayed leaving New York beyond her ordinary time. Nevertheless, her passengers, the largest number that ever left New York so early in the season, were landed in Liverpool on Saturday afternoon."

Although we have already very fully described the "Lucania," it may be convenient to reproduce here the following figures which serve to emphasise the progress which has been made in Atlantic navigation. The first steamer possessed by the Cunard Company was the wooden "Britannia," which started on her first voyage—to Boston—from the Mersey on the 4th of July, 1840—that is to say, just 54 years ago.

| | Britannia | Lucania. |
|---|---|---|
| Length | 207 ft. | 620 ft. |
| Tonnage | 1,150 | 12,950 |
| Horse-power | 740 | 30,000 |
| Speed | 8½ knots | 21½ knots |
| Consumption of coal per day | 38 tons | 600 tons |
| Passage | 14½ days | 5½ days |
| Accommodation | 115 passengers | 1400 passeng'rs |

The crew of the "Lucania" is divided into three departments, and numbers all told, sailing 54 hands, engineers and firemen 190, and stewards 179, total 423 hands.

## The Flow of Water to Propellers.

Mr. J. A. Normand, the well known torpedo boat builder, has recently published a note, in which he points out that under certain conditions a vacuum may be formed in front of the blades of a propeller. Thus, if a flat plate is moved through a mass of water, the water will tend to flow in behind it at a speed proportional to the square root of the depth of the plate below water level. At a depth of 40 inches a vacuum will be formed behind a plate moving at a velocity of about $14\frac{1}{4}$ feet per second, and at a depth of 20 feet, the water will lag behind the plate, if the velocity of the latter exceeds 36 feet per second. This phenomenon can be well observed behind the rudder of a fast torpedo boat. At quite low speeds a hollow is formed behind the rudder when it is put over quite a moderate degree, and at high speeds this hollow may extend the whole depth of the rudder. Each small area of a propeller blade must act in much the same way as this, though in this case the velocity with which the water will tend to flow in front of the propeller blades will be increased by an amount nearly equal to the speed of the ship, and hence the phenomenon is not likely to become of importance except in the case of a shallow tug towing a heavy ship, or when the propeller of a torpedo boat is brought near the surface by the pitching of the boat. Some experiments made with the first class torpedo boat No. 153 showed the loss of power due to this action very clearly. The boat, which was built for the French Navy by M. Normand, has a propeller 6 feet 8 inches in diameter by 7.8 feet pitch. The boat was moored to a quay, and her stern hoisted up by sheer legs so as to give different immersions to the screw. The height of water above the tops of the blades was in different instances 1.53 feet, 1.165 feet, .77 foot, and .54 foot. The engines in each instance were run at a number of different speeds, and the resulting thrust of the screw was measured by a dynamometer. At all depths of immersion the thrust was much the same, until a speed of about 120 revolutions per minute was reached, after which the thrust at the least immersion became markedly less than the others. Thus at this speed the thrust was about 2.6 tons in every case, but at a speed of 180 revolutions per minute the thrust was but 3.5 tons with the least immersion, 4 tons for the .77 foot immersion, and about 6 tons for the other two cases. This, however, was the limiting value for the 1.165 foot immersion, and at higher speeds but little increase of thrust was noted with this.—*The Steamship.*

## "Anarchy in High Places."

The remarkable statement of a vice-president of the Pennsylvania Railroad in regard to the free pass evil presents as discouraging a picture of the prevalent moral tone of public life as has recently been drawn. Mr. Brooks refers, apparently, in the last part of his statement, to the State of Pennsylvania. That commonwealth has had in its constitution for many years a clause prohibiting the granting of free passes, or passes at a discount, to any person except officers or employes. And yet this writer tells us that the men in that State who make the laws, the officers who execute the law and the judges who interpret the law, are beggars of passes, and are daily demanding of the roads that they violate the fundamental law to put money into the individual pockets of these men. It would be impossible to conceive of a situation more provocative of lawlessness and anarchy than this. What if it should appear, as may now seem possible, that the judges who issued the Debs injunction orders at Chicago, had their pockets full of railroad passes at the time? and that the United States marshals and other officers of the law were likewise in the pay of the railroads? This would be a situation to breed revolution. The policy of public ownership and operation of the railroads would

have to strive hard to produce so scandalous a state of things as is revealed by the recent Atchison developments and this letter of the Pennsylvania railroad official. Before we may hope to grapple successfully with the communistic spirit among the masses of the people, we have got to strike down this communism and anarchy in the higher circles of society. Out of the latter springs much of the former.—*Springfield Republican.*

### A Signal They Promptly Obeyed.

At Seventh avenue and Fifty-third street workmen of the Metropolitan Traction Company are blasting out a trench for the new cable road to be built in Fifty-third street. On a recent day, about noon, people who were passing by saw the workmen scramble out of the pit as if their lives were in danger. Every one of them seemed to make straight for the sidewalk, and they almost clambered over one another in their haste to get away. Lookers-on thought that a blast had been touched off prema turely, and they prudently withdrew some little distance to be out of harm's way.

The workmen seemed to be in such a hurry that they did not wave the red flags which serve as danger signals. People were expecting something dreadful to happen. The elevated road structure might even be shattered.

But nothing occurred. When the men reached the sidewalk, they quietly got their dinner-pails and sat down to enjoy their noon meal. They had merely heard the signal to stop work.

The foregoing from the *New York Tribune* hasn't the least point to it. There wasn't the remotest reason in the world why these men should not have got to their dinner-pails just as quickly as they pleased. Such stuff as this makes one tired.

Matheson and Grant, in their half-yearly *Engineering Trades' Report*, say that notwithstanding the extreme cheapness of steel and the more than corresponding reduction in the prices of finished work, the leading firms are only partially employed, and in seeking profit from the manufacture they have often to undertake troublesome and risky erection *in situ* at home and abroad. According to the amount of repetition, bridges up to 200 feet span can be purchased at from £10 to £13 per ton, and roof structures at from £12 to £15 per ton. During the last half year a considerable tonnage has been made for English railways at home; the bridges for the Manchester Ship Canal have been finished, but much further work in warehouses, wharfs, and other subsidiary structures will be needed. There has been a moderate export of bridges to India, China and Japan. The principal railways at home are constantly extending and rebuilding their stations, and there is much strengthening and renewing of bridges.

### Flight By Steam Power.

*Engineering*, of London, publishes in its issue of August 3d an account of the actual flight of a flying machine, constructed by Hiram Maxim, and driven by steam. The machine weighs, complete, 7,700 pounds. There are two screws 17 feet 6 inches diameter revolving 400 turns a minute and giving a total thrust of 2,000 pounds. Each of these screws is driven by a compound engine. The boiler weighs 1,000 pounds, carries 200 pounds of water and develops steam for 300 horse power. The fuel is gasolene which vaporized and burned in several thousand jets. There is an aeroplane with 1,400 square feet surface, besides which there are other wings that assist in sustaining the weight, but like the aeroplane itself have no independent motion The machine was an experimental one made to run upon a track, and with another track above designed to hold the machine down or prevent it from rising freely. During a trial which occurred July 31st, this upper track failed by the bending of an arm carrying a wheel and the machine rose but quickly came to grief through not being designedly and properly launched. Three men, including Mr. Maxim, were upon it at the time, and the result showed that a machine carrying its own fuel, boiler and engines can fly by sheer exertion of energy.

The "Campania," of the Cunard Line, arrived in New York Friday evening the 17th at the end of a trip, during which she made a new record for westward voyages of 5 days 9 hours 29 minutes, which is 3 hours 18 minutes shorter than the previous best record made by her sister ship, the "Lucania," in October last.

## MANUFACTURES.

New machinery is going in the fiber mill at Yarmouth, Me.

An electric lighting system will be established at Bloomfield, Neb.

An electric-lighting system will be established at Woodbury, N. J.

New machinery is being put into the pulp mill at Goffstown, N. H.

A $10,000 stock company will build a red cypress saw mill at Patterson, La.

The East Pond Mfg. Co., Newport, Me., will add 10 looms to their mill.

Waterwork and electric-lighting systems will be established at Crowley, La.

It is said that H. W. Hibshman will establish a hosiery mill at Fremont, Pa.

It is said that a paper box factory is to be established at Pontiac, Ill.

The Laurel Lake mills, Fall River, Mass., will shortly enlarge their plant.

An addition is being built by the Niagara Glazed Paper Co., Niagara Falls, N. Y.

Captain Becker, of Snapping Shoals, will establish a knitting mill at Madison, Ga.

Messrs. Graham & Graham, Tarrytown N. Y., will establish a wall paper factory.

The Sharon (Pa.) Iron Works furnace, employing 150 men, will resume operations in full.

English capitalists are to erect a plow factory, cotton tie mill and car factory at Gillett, Ark.

The proprietors of the new knitting mill at Green Island, Troy, N. Y., talk of enlarging the plant.

J. A. & E. F. Perkins will erect a large spool bar mill at South Twin Lake, near Medford Centre, Me.

The Seyfert Rolling Mill, at Gibraltar, Berks County, Pa., has resumed operations.

An Albany (N. Y.) firm will establish the manufacture of shoddies in the Sprague Mill at Stillwater, N. Y.

Bracey Bros. & McNair Company, of Chicago, Ill., will erect an electric plant to light Winchester and Derchard, Tenn.

The recently-burned Hilton Woolen Mills, at Edgewater, Va., will be rebuilt by Waugh, Perkins & Co., the proprietors

English capitalists have been investing in land upon which to establish factories in the vicinity of Chattanooga, Tenn.

Allen & Sherman's pulp mill, Plattsburg, Pa., was totally destroyed by fire last week. The loss is estimated at $25,000.

Certain New York men are considering the starting up of the Windsor Locks (Conn.) Steel Works, which have been shut down for nearly a year.

A newly-organized stock company will establish the manufacture of woolen goods at Sauk Centre, Minn. M. A. Scheldrup is treasurer of the company.

The Berlin Iron Bridge Co., of East Berlin, Conn., are putting up a gas house roof for the New Jersey Gas and Construction Co., at South Amboy, N. J.

The Vulcan Iron Works of Chicago are adding a new building, 125x90 feet, to their establishment. The enlargement was needed in order to keep pace with the growth of the business.

Under date of August 10th, The Lodge & Shipley Machine Tool Co., of Cincinnati, O., wrote us: "We have had more orders during the past ten days than in any month for over a year."

In the last few months the Indiana Bicycle Works, Indianapolis, Ind., have shipped bicycles to


# A NEW EDITION.

We are just printing the second edition of our "Engineers Epitome." [Price 50 cents, postpaid.]

**MASON REGULATOR CO., Boston.**

I have received the "Epitome" and am well pleased with it. It is the best book for the money I ever saw. J. B. PETERIE, Old Victoria Mines, Cape Breton, N. S.

**BUFFALO DRILLS.** For Blacksmith, Carriage & Wagon Manfrs. 24 Sizes. Buffalo Forge. Buffalo, N.Y. U.S.A.

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**CLEVELAND** 86 SENECA ST., Near Union Depot. NEW GEAR SHOP. GEO. B. GRANT.

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Part I.—Progressive Exercises.
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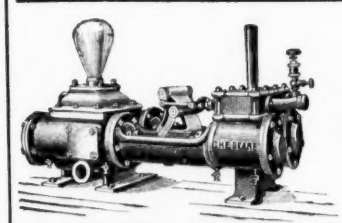
**JESSOP'S STEEL** FOR TOOLS, DRILLS, DIES, &c. ALL KINDS IN STOCK. Manufactory, SHEFFIELD, ENG. Chief Am. Office, 91 JOHN ST., N. Y. WM. JESSOP & SONS, LTD. Established a century ago. Medal World's Columbian Exposition 1893.

"Star" Foot Lathe Swings 9x25 in. LATHE Screw Cutting Automatic Cross Feed, etc. Scroll Saws, Circular Saws, Lathes Mortisers. Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co., 687 Water St., Seneca Falls, N.Y.

**BORING AND TURNING MILLS**
ARE SUPERIOR TO LATHES FOR FACE PLATE WORK.
We have a variety of sizes and a large stock for immediate shipment.
BRIDGEPORT MACHINE TOOL WORKS,
E. P. BULLARD, Prop. BRIDGEPORT, CONN.
New York Office, 86 LIBERTY STREET.



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CRESCENT STEEL. ESTABLISHED 1865 ✻ INCORPORATED 1889. **CRESCENT STEEL CO.** 480 PEARL ST. NEW YORK. PITTSBURGH, PA. 64 & 66 S. CLINTON ST. CHICAGO.

**FINE PULLEY TAPS, HIGHEST QUALITY.**
"Lightning" and "Green River" Screw Plates, Taps and Reamers of all kinds.
Bolt Cutters, Drilling Machines, Punching Presses, etc. Send for Catalogue.

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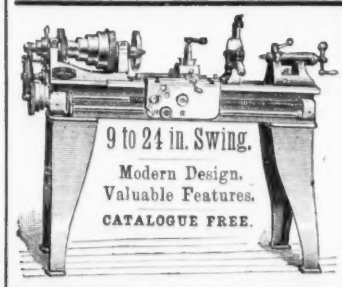
**"R. MUSHET'S SPECIAL STEEL"**
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
Sole Representatives in the United States.
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St., NEW YORK: 143 Liberty St.




**Here's a Lathe We're Proud Of!**
And what's better, our customers are always highly pleased with our tools; the workmanship, material and finish are of the highest order, while our designs are the latest and most approved. We are quoting specially low prices just now. Our catalogue will tell you all about our tools—sent free.
SEBASTIAN LATHE CO.,
117-119 CULVERT ST., CINCINNATI, OHIO.

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*ASBESTOS SECTIONAL PIPE COVERINGS.*

Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, etc.
Asbestos Boiler Coverings.
H. W. JOHNS MANUFACTURING COMPANY,
H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.
87 MAIDEN LANE, N. Y. Jersey City. Chicago. Philadelphia. Boston. London.

Russia, Denmark, Vienna, Sweden, Honolulu, Mexico, and a number of other foreign countries.

The wire nail department of the American Wire Nail Company, at Anderson, Ind., has resumed operations, putting 400 men to work. The rod department of the works has also resumed operations.

It is contemplated to develop the water power of the Etowah River, at Rome, Ga., and erect a plant for supplying electricity to the city. Z. B. Hargrove, J. W. Rounsaville and T. F. Howell are interested.

The Worthington Hydraulic Works, at Brooklyn, N. Y., have decided to make large additions to their already extensive plant, and have placed the contract for this work with the Berlin Iron Bridge Co., of East Berlin, Conn.

Out of the eight of the great manufacturing industries of Braddock, Pa., only one is now idle, the Edgar Thomson Steel Works, which includes the converting, bloom and rail departments, and the forge. It will resume.

The resumption of work at the Coleman-Shields Company's mills, at Niles, Ohio, gave employment to all the idle men in the town, and to many from adjacent places. Every manufacturing concern in Niles is running on full time.

Work has been resumed in every department of the New Haven Clock Company, and fully 500 employes, who have been idle over a month, have returned to work. The company reports an unusual number of orders on hand.

On August 20th, application will be made to charter the Brady's Bend Coal and Iron Company, of Kittanning, Pa. A number of capitalists, together with W. J. Hammond, and W. J. Hammond, Jr., of Pittsburgh, are interested.

The Sylvan Steel Company, of Moline, Ill., have broken ground for the erection of a building 190x260 feet. It will be constructed with steel frame work, and it is expected to have the building ready for occupancy within sixty days.

The Wetherald Rolling Mill Company, of Franklin, Ind., has been incorporated. The plant of this company consists of five scrap furnaces, three heating furnaces, and three trains of rolls, and was removed from Findlay, O., in 1893.

One end of the present foundry building of the Birmingham (Conn.) Iron Foundry has been torn out preparatory to running the foundations of the new building through. The new building will take in part of one of the cupolas of the old foundry.

The Parsons Tool Company, of Cleveland, has been incorporated by Frederick W. Parsons, Frederick P. Root, Robert A. Edmeston, Earnest P. Parsons, and J. F. Herrick. The capital stock is $50,000, and the purpose, the operating, manufacturing, and selling the double tool head for iron planers and shapers patented by F. W. and E. P. Parsons.

Duthie & Daggett, manufacturers of fine tools at Indianapolis, Ind., have leased the entire building on South Meridian street, formerly part of the Bryce bakery, occupying both stories of the building, which is ninety-five feet in length by fifty in width.

The Rice & Sargent Engine Co., of Providence, R. I., has received an order for the steam engine to be used in the new and extensive plant of Howard & Bullough, American Machine Company, manufacturers of cotton machinery at Pawtucket, R. I.

The Ely Novelty Works, situated in Girard, Pa., were entirely destroyed last week by fire. The absence of any kind of protection against fire, except a cistern, almost caused the entire destruction of the town. The loss is estimated at $25,000, and upon that there was insurance of about $4,000.

The building of the new Pittsburgh Tin-plate Works, at New Kensington, Pa., has begun. The main building is to be 100x40 feet, with a boiler house 48x35 feet, and picking room 35x30 feet. The entire building, with the exception of the picking house, is to be of structural steel. The plant is laid out for six full mills.

The Dodge Manufacturing Co., Mishawaka, Ind., branch house No. 43 Dey street, New York, has issued a 200-page catalogue of power transmission appliances, including their well-known wood split pulley. The catalogue gives a very comprehensive list of common and uncommon machinery used in the transmission of power, in the introduction the company saying: "In compiling this catalogue we have endeavored to include everything necessary to a complete line of power transmitting machinery."

A special to the *Evening Post* from Raleigh N. C., says: Pacolet Mill No. 3, near Spartanburg, S. C., will put in 136 additional looms. These will make a total of 3,100 looms in operation in the three Pacolet and the Spartan mills. A new mill company, to be known as the Nesbitt Shoals Company, will be organized in a few days, to build a 30,000-spindle mill at Nesbitt Shoals, in Spartanburg County, S. C. The Lockhart Shoals (S. C.) mills are building. These mills, which will be of brick and stone, will be 126 feet wide, and 270 feet long.

The Dugdale Can Company is in its harvest time. The rule is that each man shall, with a machine, turn out 6 000 cans every ten hours. If the task is accomplished before the ten hours the man can quit and go home, but so pressing with orders are the works now that the men are working overtime, and for some time past the works have been turning out 80 000 cans per day. It is stated that most of the cans are sold in Indiana, Illinois and Ohio, the company extending its business despite the gloomy canning outlook in this State.—*Indianapolis Journal.*

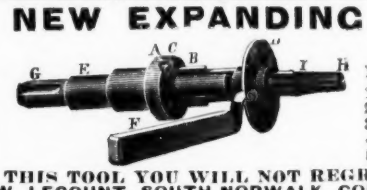
The four new mills at the tin plate factory will be ready to operate by September. When the nine mills are in operation the American tin plate plant of this city will be by far the largest in the world Five mills have been in operation for several months and the amount of tin turned out is simply enormous. The order book is crowded all the time and a vast amount of the product is daily leaving Elwood for all parts of the world. This enlargement almost doubles the present capacity and output of the factory, and will furnish employment to fully 200 more people, greatly enlarging the pay roll and proving a big thing for Elwood. The four new mills will be ready to start up not later than September, and then the factory will employ over 500 hands and turn out 5,000 boxes of finished tin each week.—*South Bend* (Ind.) *Weekly Journal.*

The Buffalo Forge Co., Buffalo, N. Y., has received recent orders for their heating and ventilating system as follows: Ashland Avenue High


DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING
NICHOLSON.

NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.
3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

LECOUNT'S NEW EXPANDING MANDREL.
Amateur's Size.
Taking anything from 1/8 to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.



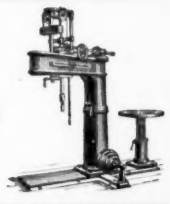

Machinist's Size.

| No. | | | Price. |
|---|---|---|---|
| 1 | 1/16 to 1 | in. | $10 |
| 2 | 1 " | 1 1/16 " | 14 |
| 3 | 1 1/16 " | 2 " | 18 |
| 4 (with screws) | 2 " | 3 " | 32 |
| 5 " " | 3 " | 4 " | 44 |

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L'td. 21 Cross St., London, England.

DID YOU EVER?
Hear of a Coal-dealer recommending an INDICATOR? Send for our catalogue of the "ROBERTSON-THOMPSON" "IMPROVED STRAIGHT-LINE" INDICATOR Reducing wheels Planimeters Smoke eliminators Oil filters & extractors Blowing grate bars Feed water heaters and a number of other specialties, to
Ames & Robertson Co. 61 CORTLANDST N.Y.

BETTS MACHINE COMPANY,
MACHINE TOOL BUILDERS,
WILMINGTON, DEL.



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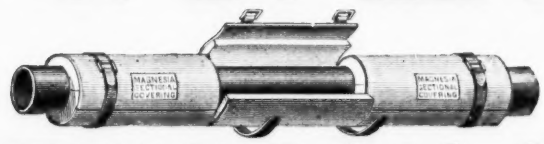
Sectional Steam Pipe and Boiler Coverings.
ABSOLUTELY FIRE-PROOF.



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Baltimore, Wallace & Bro., 432 E. Pratt St.
Washington, Wm. B. Morgan, Builders' Ex'e.
New Orleans, Delbert Engineering Co.
Memphis, Symmes & Co., 192 Front St.

SELLING AGENTS.
Milwaukee, F. Sprinkman, 133 Sycamore St.
St. Louis, F. Boecler, 108 Walnut St.
Detroit, S. P. Conkling, 20 Atwater St., East.
Denver, C. W. Badgley & Co., 18th & Market Sts.
Salt Lake City, Utah & Montana Mach'y Co.
Butte City, Mont., R. W. James.
S. F'ncisco, DeSolla & Deussing, 2 California St

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MANUFACTURERS OF THE CELEBRATED
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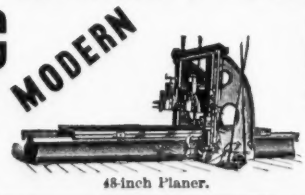
AND OTHER METAL-WORKING MACHINES,


48-inch Planer.

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BUILDERS IRON FOUNDRY,
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"OUR SHARE IN COAST DEFENCE—PART III."
The 12-inch Breech-Loading Rifled Mortars described in our pamphlets, "Our Share in Coast Defence—Part I and Part II," have proved so attractive a subject that we have thought a description of the carriages on which these mortars are mounted will also be of interest to engineers and machinists. We accordingly publish and will mail on application, a pamphlet giving a full account of the construction of the carriages.

COOKE & CO.,
163 & 165 Washington Street,
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WATERS PERFECT ENGINE GOVERNOR.
Simplest and most sensitive.
WRITE FOR PRICE LIST AND MENTION THIS PAPER.

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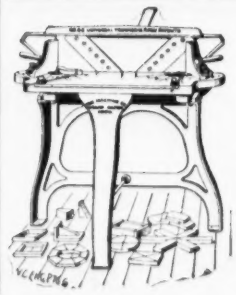
Our New and Revised Catalogue of Practical and Scientific Books, 88 pages 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.



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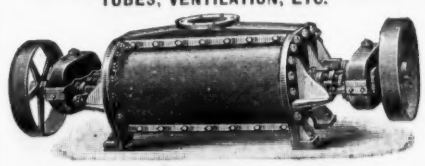
Universal Trimmer
is the only one that has an accurate adjustment of the gauges. Cannot be set wrong. Work must be correct. Time saved in Pattern-making and all wood-working.
CATALOGUE FREE!
FOX MACHINE CO.,
325 Nor. Front St., Grand Rapids, Mich.
135 Finsbury Pavement, London, England.

ROOT'S FORCE BLAST ROTARY BLOWER.
For FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.



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BEST MECHANICAL CONSTRUCTION.
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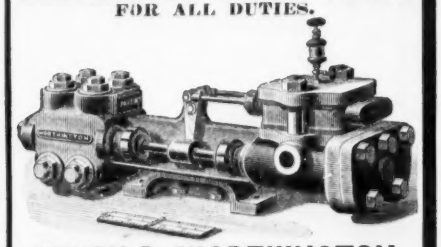
CONNERSVILLE, IND.
Chicago Office: 1405-10 Manhattan Building.
S. S. TOWNSEND, Gen. Agent. } 163 & 165 Washington St.
COOKE & CO., Selling Agents. } NEW YORK.
In Writing Please Mention This Paper.

WORTHINGTON STEAM PUMPS
FOR ALL DUTIES.



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CHICAGO, 185 to 189 Van Buren St.
ST. LOUIS, Eighth and St. Charles Sts.

School, Denver, Col., requiring two (2) fans, 130 inches and 100 inches respectively, with heaters containing nearly 30,000 feet of 1-inch pipe; Dartmouth Street School, Worcester, Mass; Grammar Schools, Nos. 59 and 79, New York City, 130-inch and 140-inch fans, respectively; Oregon State Agricultural College; Pennsylvania State College, State College, Pa.; several Detroit Public schools; Eldora High School, Eldora, Ia.; Kirkwood Hall, Bloomington, Ind.; Mason City High School, Mason City, Ia; George W. Childs School, Philadelphia; Ninth Ward School, Rutland, Vt.; Bank of Commerce, Buffalo, N. Y.; Erie County Penitentiary, Buffalo, N. Y.; Gallopolis Epileptic Asylum, Gallopolis, O. (nine buildings); Baltimore Music Hall, Baltimore, Md.; Denver State Capitol, Denver, Col.; National Union Building, Toledo, O.; Brooklyn High School, Brooklyn, N. Y.; Erskine Church, Montreal, Que.; Old Ladies' Home, Englewood, N. J.; State Insane Asylum, S. C.; Winnebago County Asylum, Wis.; Bay Shore School, Bay Shore, L. I.; New York High School, Delevan Wis.; Tenth Ward Public School, Milwaukee, Wis.; Lancaster High School, Lancaster, Wis.; Fifth Ward School, Milwaukee; Normal School, Pasadena, Cal.; Stevens Point Normal School, Stevens Point, Wis.; State University, Minneapolis, Minn.; Union Depot, St. Louis, Mo. The Buffalo Forge Co. has been running right along full time to keep up with orders.

## Machinists' Supplies and Iron.

NEW YORK, August 18, 1894.

Iron—American Pig—We quote standard brands, $12.50 to $13 for No. 1; $11 to $12 for No. 2. Southern brands, $11.50 to $12.25 for No. 1; $10.50 to $11 for No. 2; $10 to $10.25 for No. 3; $10.50 to $11 for No. 1 soft; and $10.25 to $10.75 for No. 2 soft. Foundry No. 4, $9.75 to $10.25.

Antimony—We quote L. X., 8⅝c. to 8¾c.; Cookson's, 9¾c. to 10c.; Hallett's, 8.1¼c. to 8.¼c; and U. S. French Star, 10c.

Lard Oil—We quote 55c. to 57c., according to quantity.

Copper—The market is scarcely active, with prices favorable to the buyer. For Lake Copper 9½c. to 9¼c. is asked, but large quantities can be bought at 9c. or even lower. Holders of Casting Copper are more liberal in their offers; it is said that 8½c. has been accepted.

Lead—The market is very unsettled. Spot lead is quoted at 3.50c. to 3.60c., futures at 3.35c. to 3.50c. The demand is very light.

Spelter—The market is weak; 3.45c. is quoted for New York delivery. Buyers are well supplied, and are not eager to buy.

Tin—The market closed steady, with slightly higher prices. For spot 19.30c. is asked, and sales made at this figure.

## WANTED

*"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

Machinist wanted in a small shop in Wisconsin. Address, with references, J. R., AM. MACHINIST.

Wanted—A mech. d'ftsman. P. O. drawer No. 63, New Haven, Ct., stating age, exp. & pay expected.

Foundry eng'r., German, unmarried, 10 yrs. exp., pract. & theor. educated, desires pos. S. H., AM. MA.

Draftsman wants position; first-class; exp'd in mach. tools and general mach'y. Box 146, AM. MACH.

Draftsman—Young man, tech. educ'n and exp. in ice machine design, wants pos. Box 142, AM. MACH.

Mech'l eng., member of A. S. M. E., is open for a pos. as chief draftsman. Box 147, AM. MACHINIST.

A mechanic with technical education and experience in fitting up for manufacturing, desires a position. Box 138, AM. MACHINIST.

Situation wanted by a supt. experienced in mfg. tools and milling machines, design ways and means to economize. Box 144, AM. MACHINIST.

Wanted—Patternmaker; age 25 to 30; fair experience, as partner in foundry. Write J. McCash, 619 Harris Avenue, St Louis, Mo.

Wanted—Active men; mechanical, civil, electrical engineers or draftsmen, well acquainted in their localities. Edwin Guthrie, Washington, D. C.

By young man, 28, position; experience in tank, truss, sheet iron work of modern make; 2 years of foremanship in the same; references. Box 141, AMERICAN MACHINIST.

Wanted position in college or trades school as instructor in patternmaking and mechanical drawing; thoroughly acquainted with manual training in every detail; highest reference. W. G. H.O. A.M.

Situation wanted—A practical man with exp. & ref., wants control of foundry plant; understands his business thoroughly as mechanic and manager. Box 145, AMERICAN MACHINIST.

Wanted—A first-class all-around machinist familiar with gear cutting. Address, giving age, experience, references and terms. Central New York, AMERICAN MACHINIST.

An expert mech eng. & d'ftsman, pract. machinist, has wide exp. in drawing room & shop; well qualified to develop new ideas and further employer's interests, is open for position in office or shop. Box 140, AMERICAN MACHINIST.

Position as superintendent or assistant in machine shops is desired. Have had wide exp. in design'g and construct'g isolated and town electric light'g plants. Rope driv'g and econom'l unn'g of large power plants a specialty. A. B. C., AM. MACH.

Wanted—A company manufacturing special machinery of fine quality and intending to employ from one to two hundred men, desires to secure the services of a superintendent of thorough experience in the best American shops. One capable of getting out the best work at fair cost in the most expeditious way, and a thorough organizer and manager of men is the one sought for. The right man will be fairly paid. Address Manufacturer, 80 Market space, Washington, D. C.

## ✣ MISCELLANEOUS WANTS ✣

*Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Wanted—To buy good second-hand tools. Box 83, AMERICAN MACHINIST.

For sale—Machine tool drawings, new & correct. George W. Hart, 85 Ludlow Street, Cincinnati, O.

For Sale—Foundry and machine shop in Florida. Paying business; small capital. Address Mch., AMERICAN MACHINIST.

Ice machine builder, wishes to go in partnership with a party possessing a machine shop; has machines running & patent. Box 143, AM. MACHINIST.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Do you want a picture of the famous Locomotive "999?" Send 50 cents for our fine copper plate *transparent* picture (14x28), showing all parts *inside* and *outside*, all named and numbered, on satin gloss paper, for framing, educational, beautiful, correct. Locomotive Engineering, 256 B'way, N.Y.

For sale—A first-class foundry thoroughly equipped with modern appliances, together with the real estate on which it stands. The plant has been successfully conducted for over twenty years and is now offered for sale because of owner's death. For further particulars inquire of Thomas J. Kelley, administrator, Willimantic, Conn.


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ESTABLISHED IN 1874.

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100 and 102 Reade Street, New York.
85 Queen Victoria Street, London, Eng.
5 Neue Promenade, Berlin, C., Germany
Cor. Lake and Kirtland Streets, Cleveland, O.

DETROIT TWIST DRILL CO., DETROIT, MICH., U. S. A.
SOLE MANUFACTURERS OF
GRAHAM'S GROOVED SHANK TWIST DRILLS AND CHUCKS.

Endorsed by Practical Mechanics Everywhere. Send for Catalogue.

SECOND-HAND MACHINE TOOLS,
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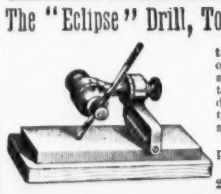

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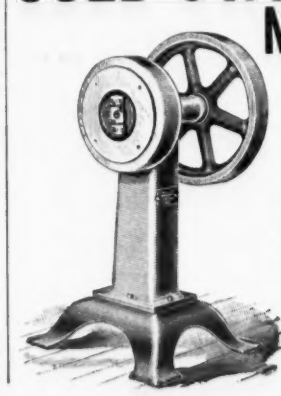

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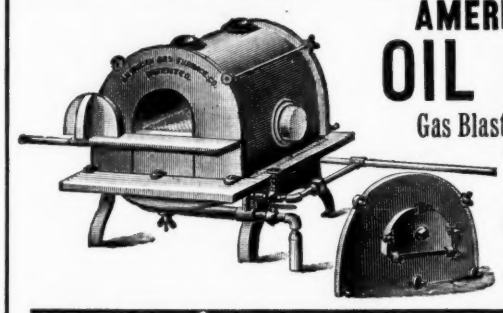

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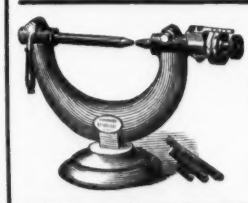

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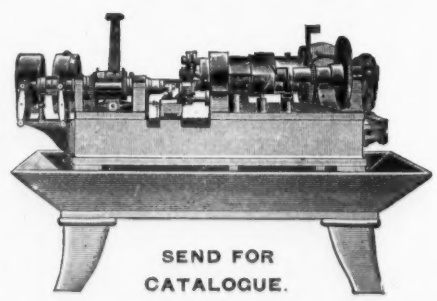

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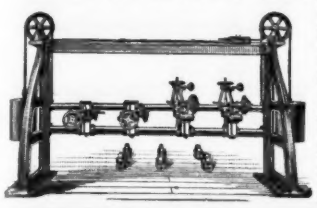

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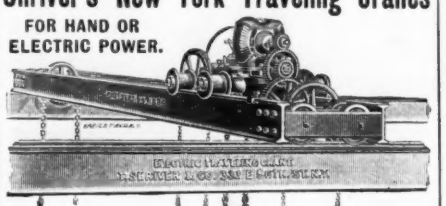

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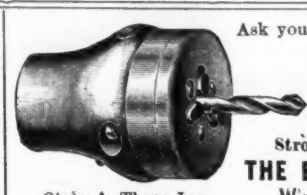

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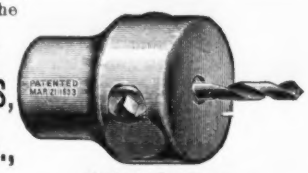

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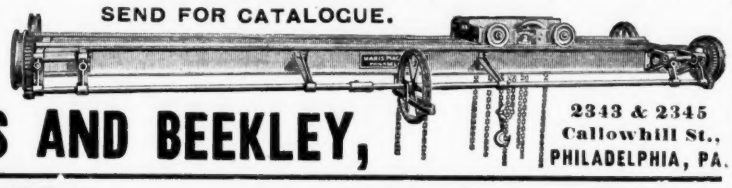

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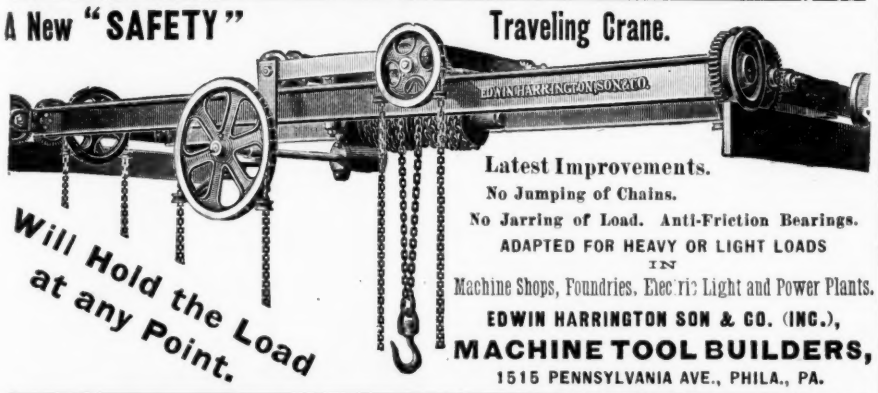


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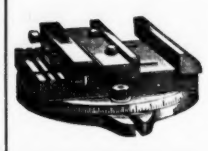

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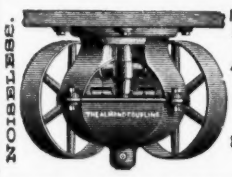

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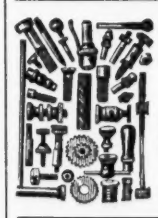

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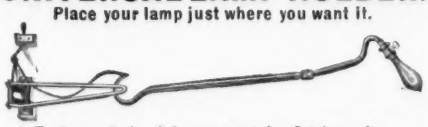

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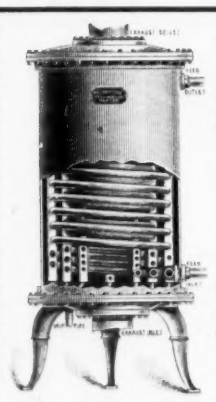

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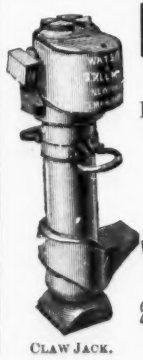

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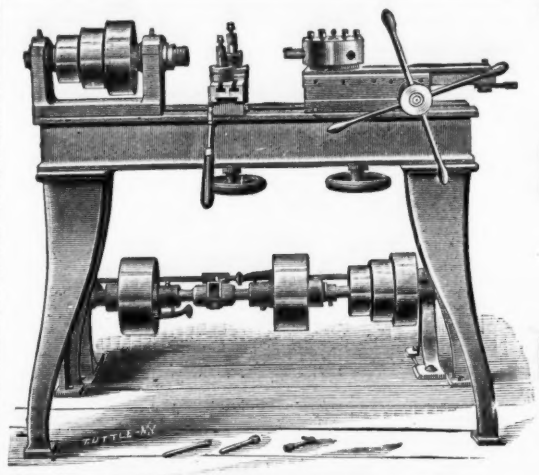

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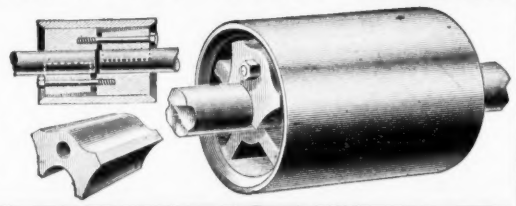

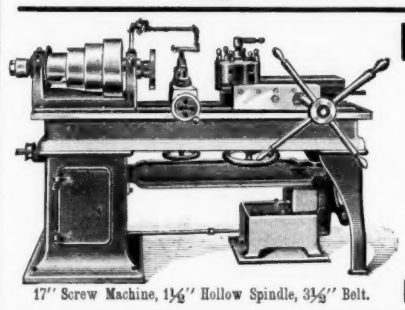

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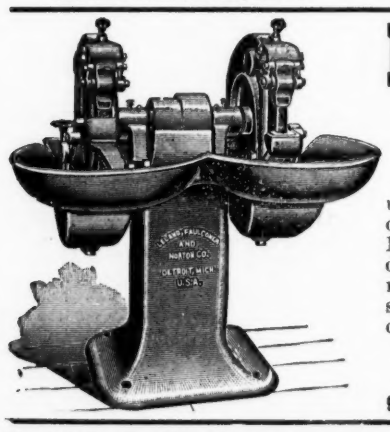

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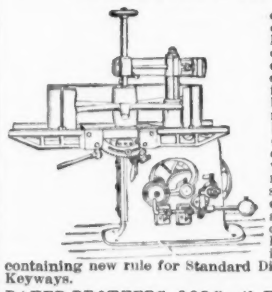

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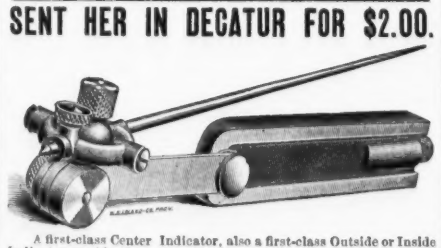

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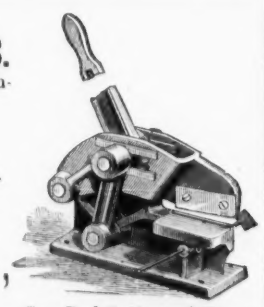

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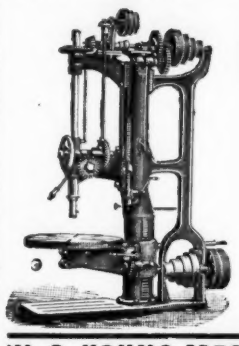

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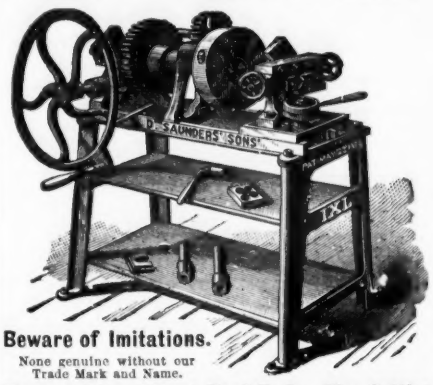


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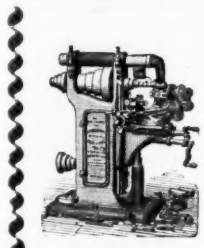

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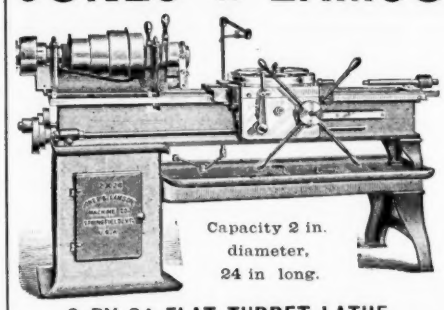

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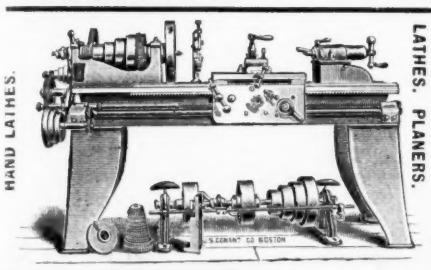


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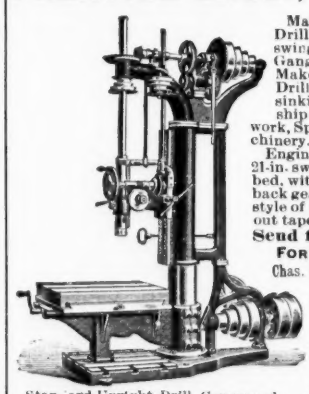

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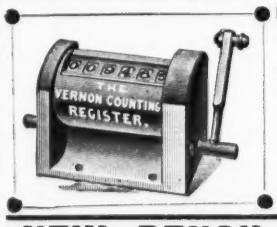


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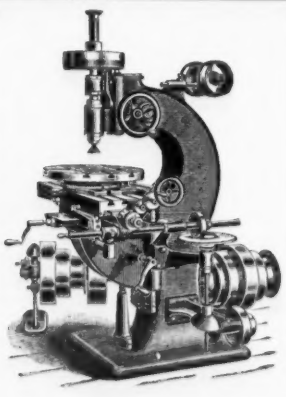

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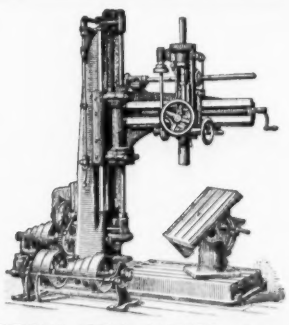

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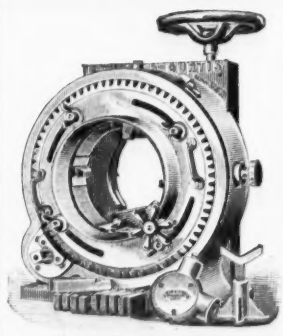

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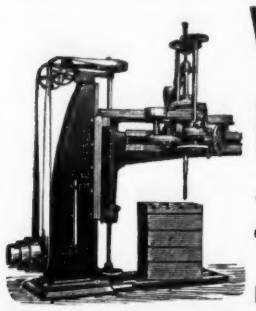

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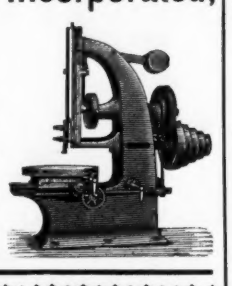

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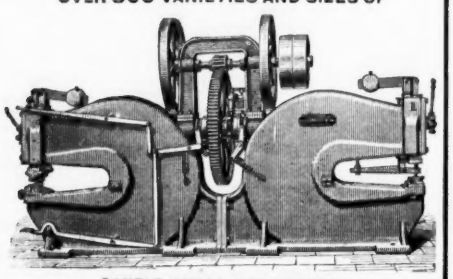

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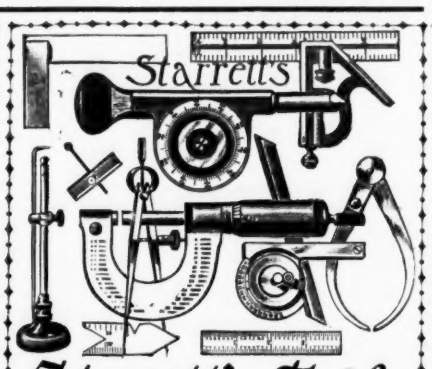


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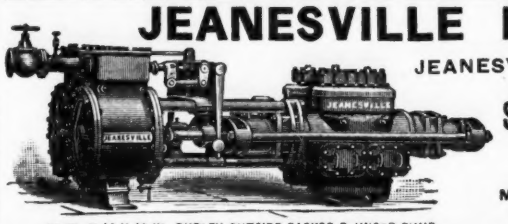

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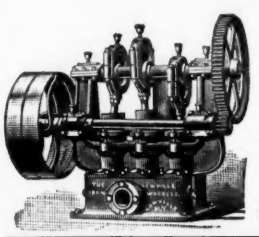

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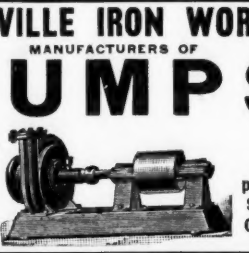

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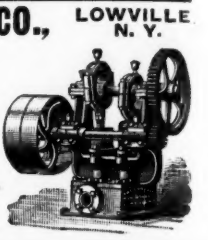

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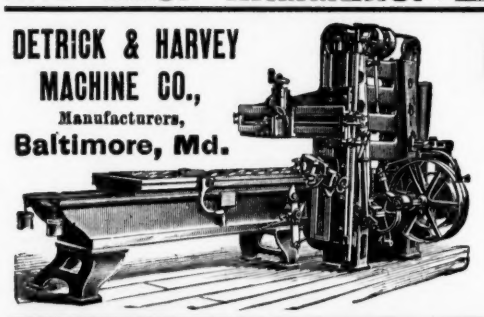

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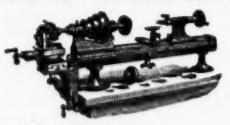

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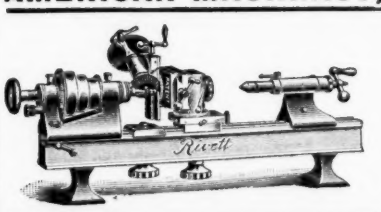

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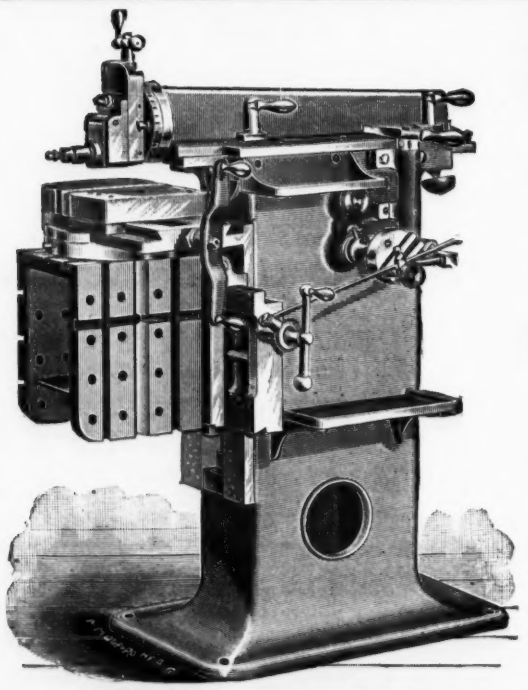

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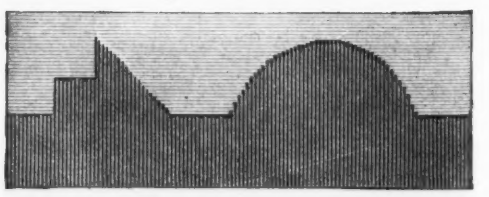

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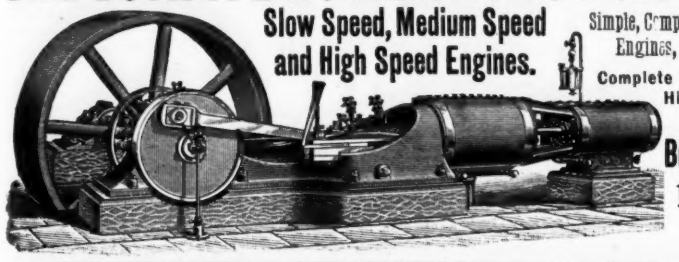

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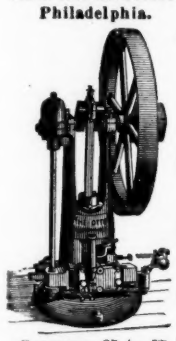

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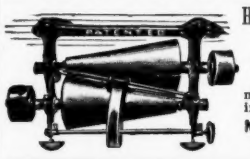

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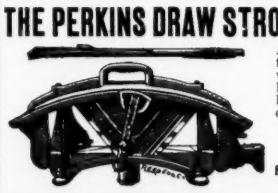

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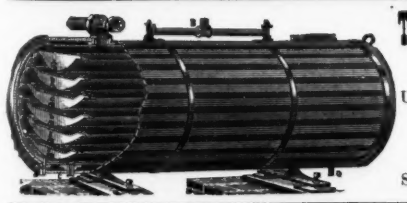

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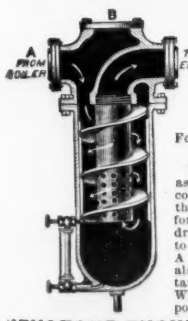


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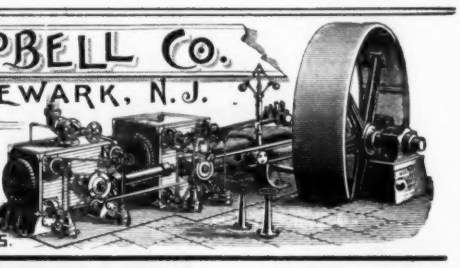

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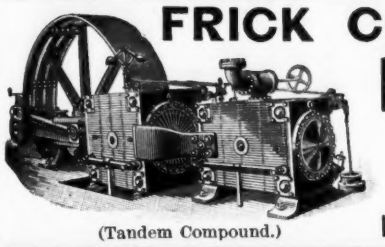

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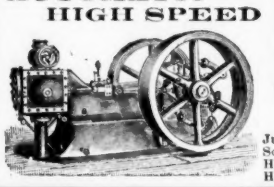

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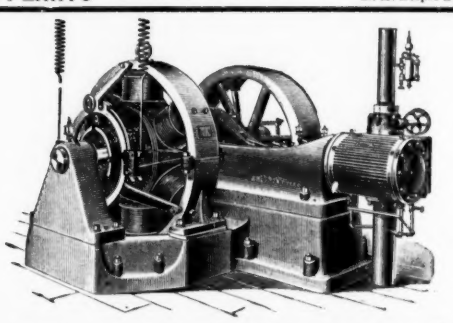

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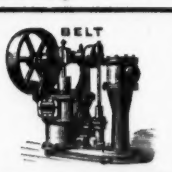


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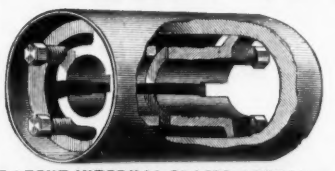

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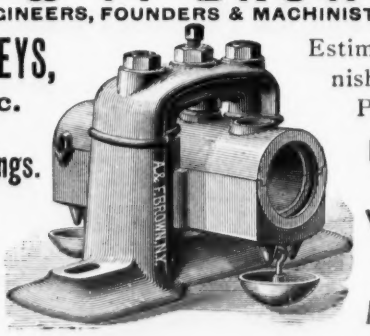


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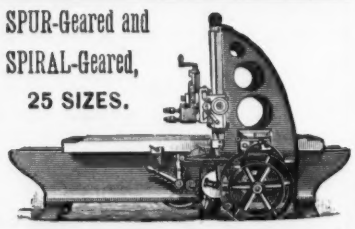

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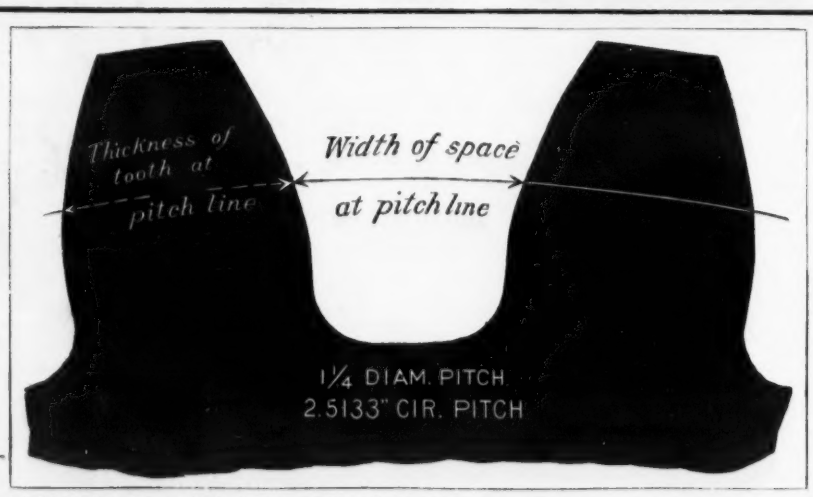


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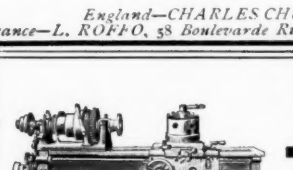

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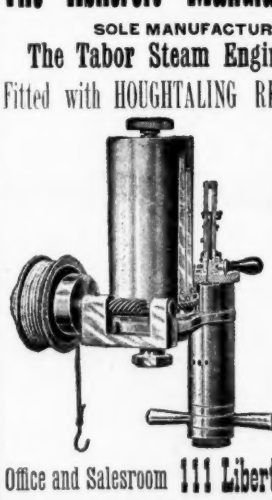

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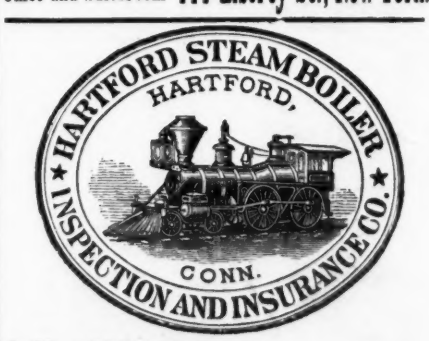


J. M. ALLEN, President
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. Pierce, Secretary & Treasurer.

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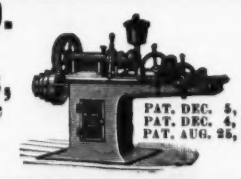
**THE ACME MACHINERY CO.**
CLEVELAND, OHIO.
Manufacturers of
**ACME BOLT & RIVET HEADERS,**
Acme Single and Double Automatic
**BOLT CUTTERS.**
Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.

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# MACHINE TOOLS AT REDUCED PRICES.

In order to reduce our stock, we offer 16″, 18″, 21″ and 24″ engine lathes, 16″, 22″ 24″ and 27″ planers, 10″, 12″ and 15″ speed lathes, 15″ and 20″ turret lathes, at a good discount from former prices.

We also have a few 16″ and 18″ second hand engine lathes, in good order, and of our own make.

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